US006242130B1

(12) **United States Patent**
Noh et al.

(10) **Patent No.: US 6,242,130 B1**
(45) **Date of Patent: Jun. 5, 2001**

(54) **CASE CONTAINING SECONDARY BATTERY**

(75) Inventors: **Hyung-gon Noh**, Seoul; **Jong-hoon Yun**, Pusan, both of (KR)

(73) Assignee: **Samsung SDI Co., Ltd.**, Kyungki-do (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/328,795**

(22) Filed: **Jun. 9, 1999**

(30) **Foreign Application Priority Data**

Jul. 29, 1998 (KR) 98-30677

(51) **Int. Cl.**[7] **H01M 2/02**; H01M 2/04

(52) **U.S. Cl.** **429/175**; 429/176; 429/178

(58) **Field of Search** 429/175, 176, 429/163, 178; H01M 2/02, 2/04

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Primary Examiner—John S. Maples
(74) *Attorney, Agent, or Firm*—Leydig, Voit & Mayer, Ltd.

(57) **ABSTRACT**

A case for a secondary battery includes a pan having a space for accommodating a battery main body and an opening. A first bonding portion extends along the edge of the pan. A second bonding portion extends along the edge of the cover portion for corresponding attachment to the first bonding portion when folded onto the pan. Thus, mass production of the case is possible and the bonding portion becomes firm when the first and second bonding portions are bonded together.

9 Claims, 6 Drawing Sheets

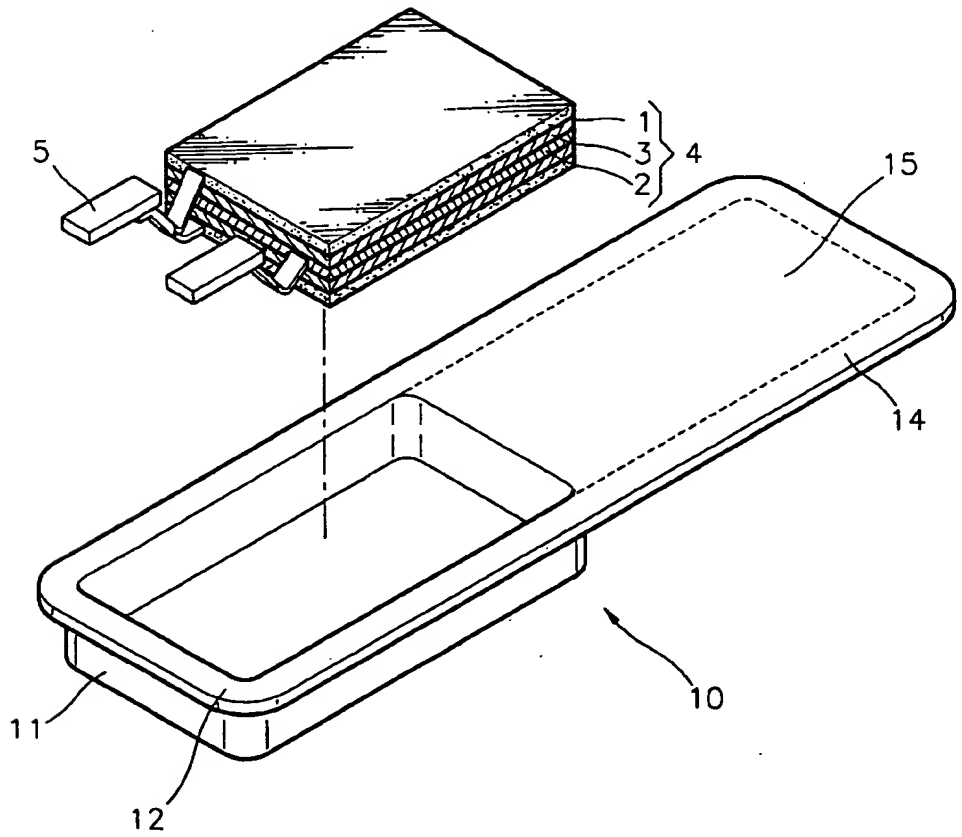


FIG. 1

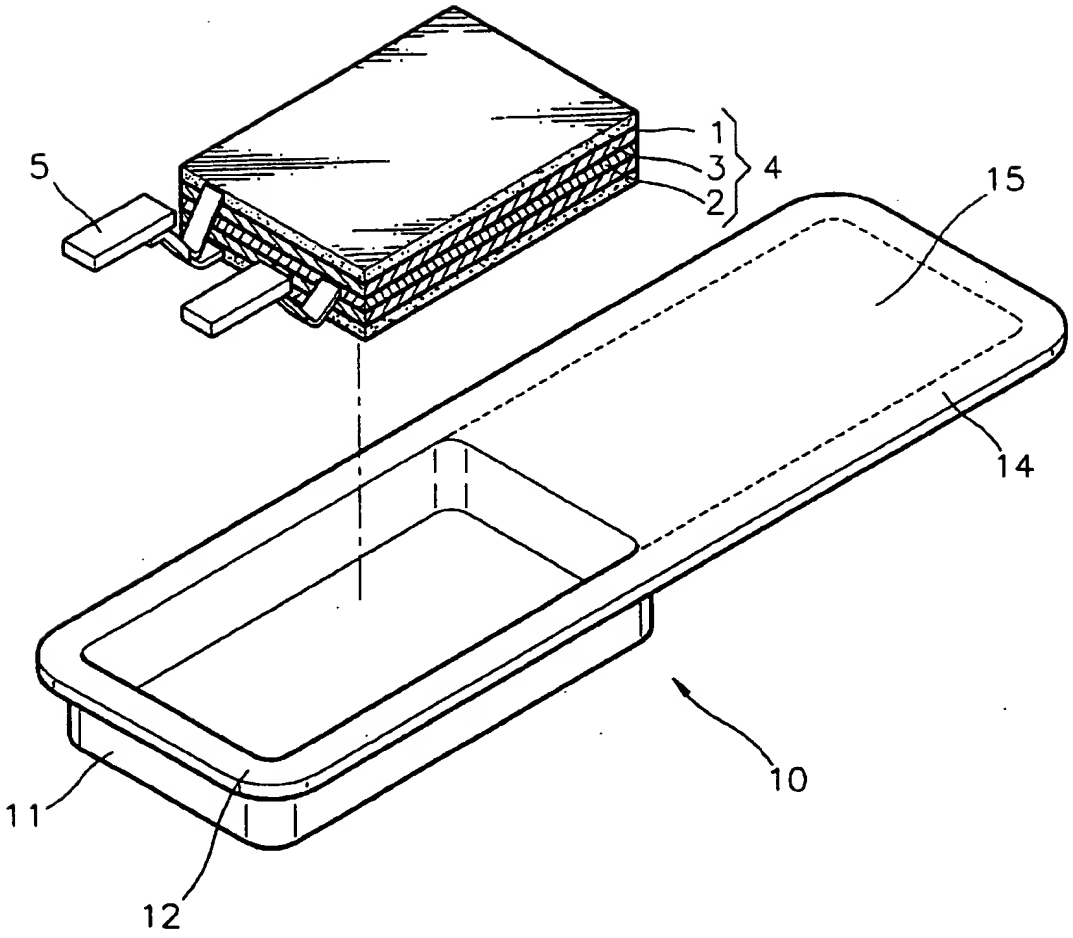


FIG. 2

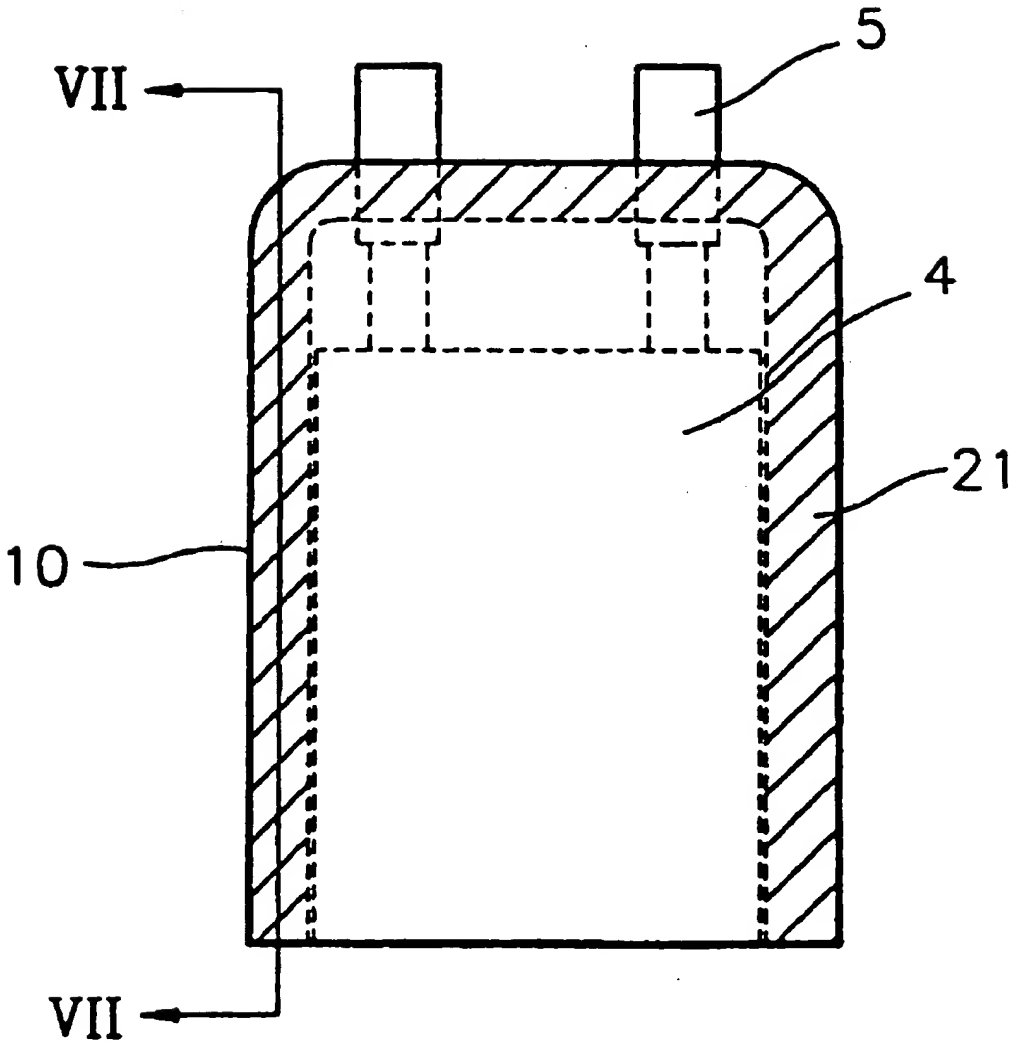


FIG. 3

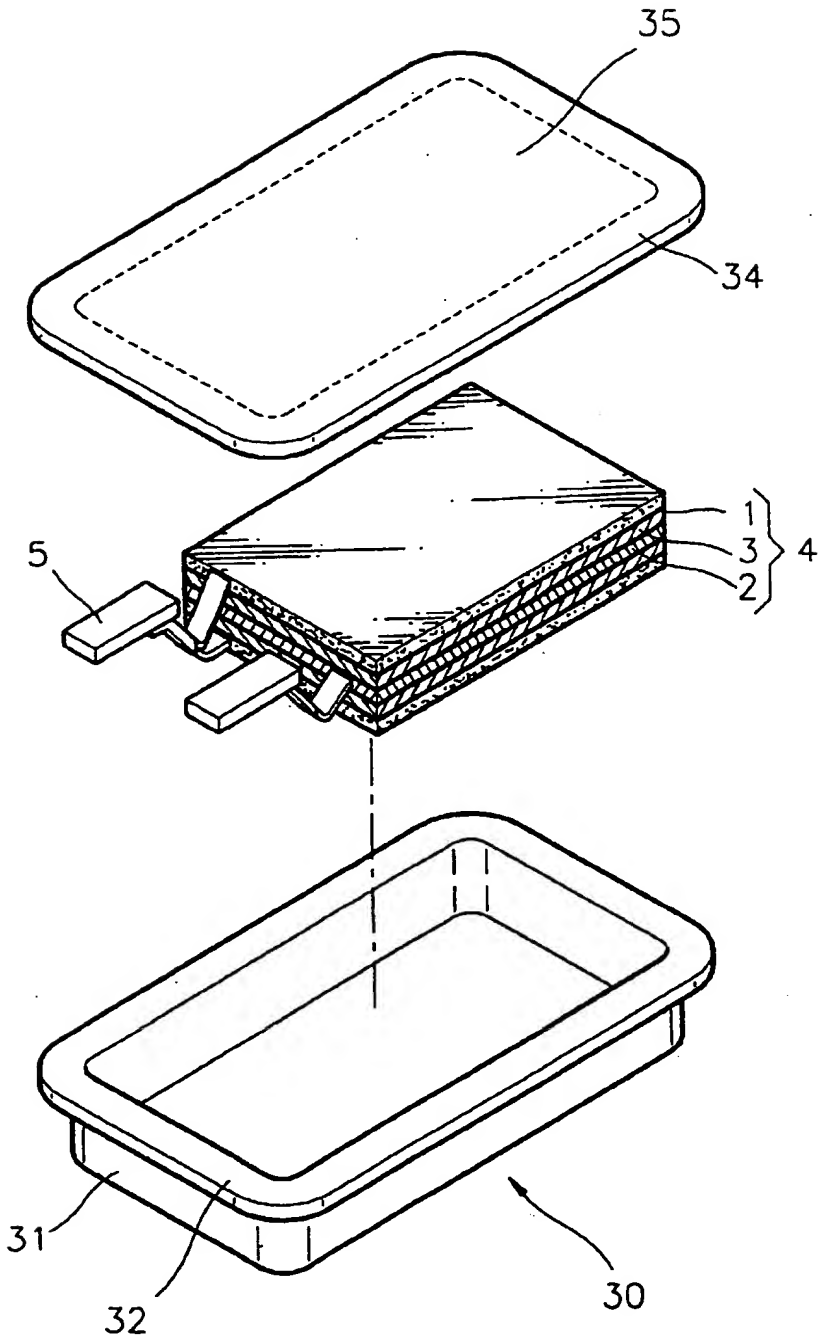


FIG. 4

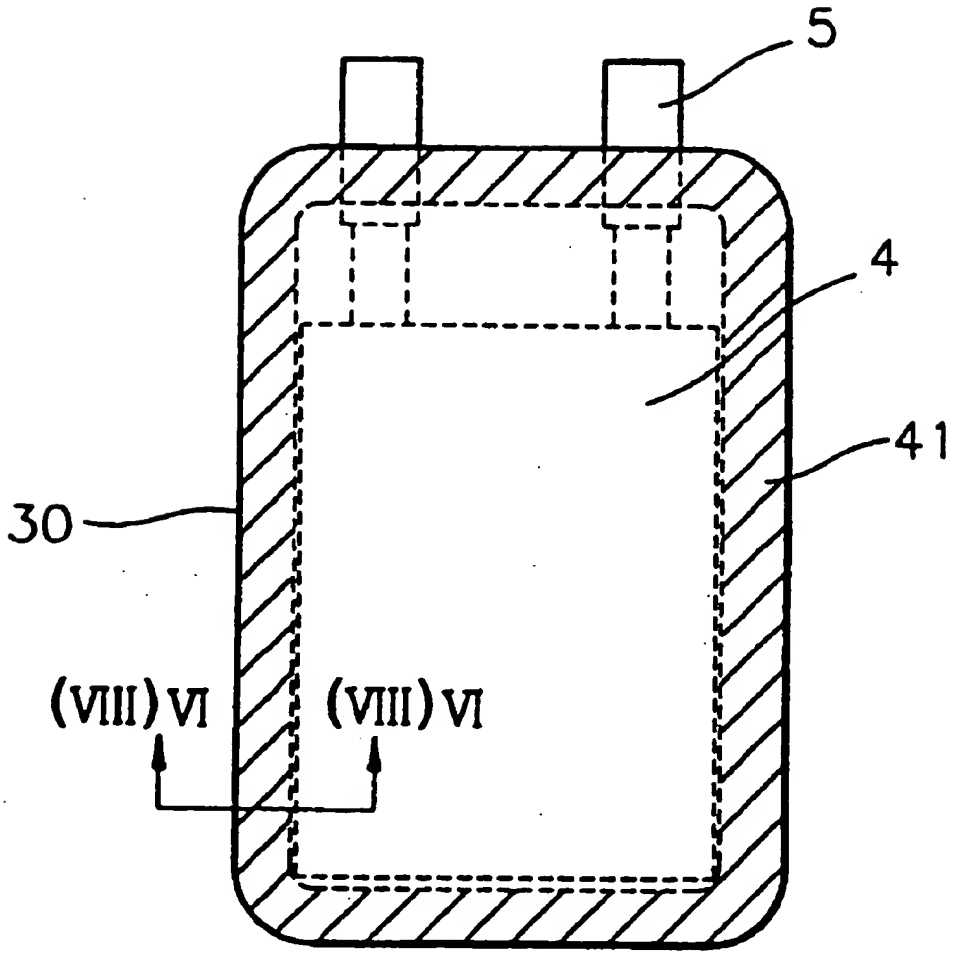


FIG. 5

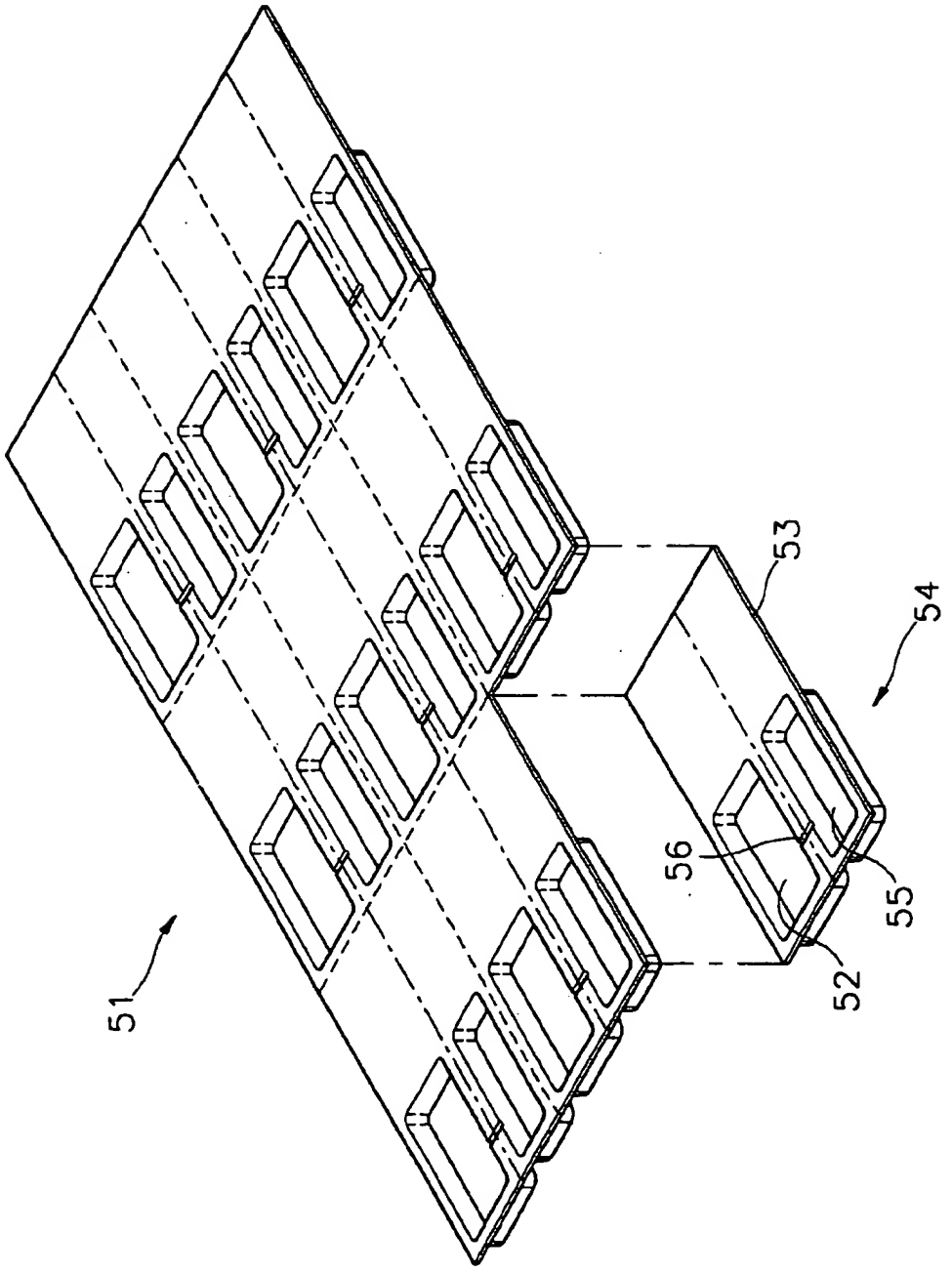


FIG. 6

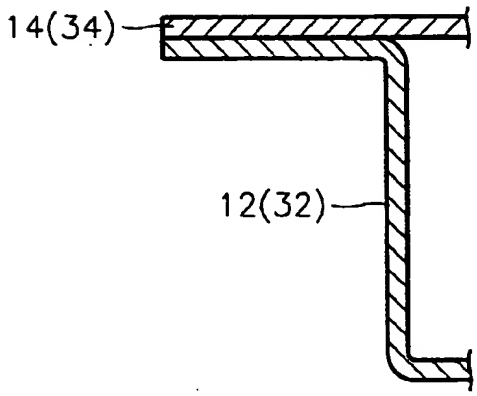


FIG. 7

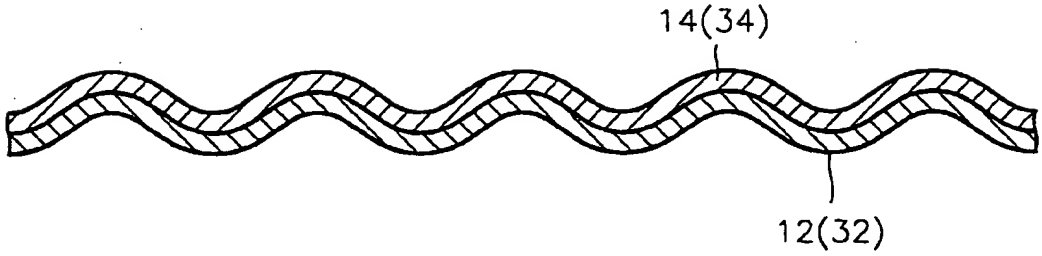
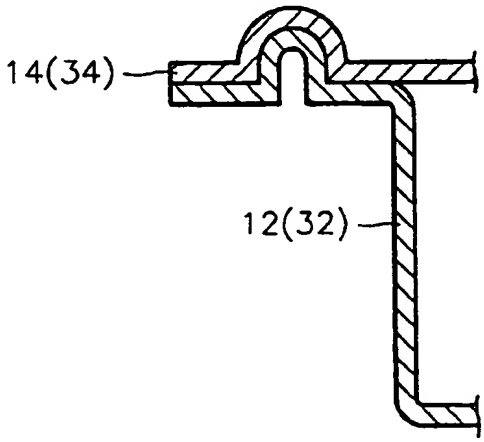


FIG. 8



CASE CONTAINING SECONDARY BATTERY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a case for a secondary battery and a manufacturing method thereof, and more particularly, to a case for a secondary battery which seals a main body of a current-generating battery, and to a manufacturing method thereof.

2. Description of the Related Art

Secondary batteries usually include a battery main body for generating current formed by stacking an anode plate, a cathode plate and a separator. An electrode terminal is connected to the battery main body which functions as an electrical passage to the outside. The battery main body and a portion of the electrode terminal are coupled, forming a seal.

According to the conventional technology, a lithium secondary battery is manufactured after the battery main body is inserted in a case in the form of a pouch. However, due to the structure as above, mass production of the battery is not easy and furthermore a bonding surface which closes a receiving portion of the case where the battery is received is not stable.

SUMMARY OF THE INVENTION

To solve the above problems, it is an objective of the present invention to provide a case for a secondary battery which can be manufactured through mass production and has an improved bonding surface.

It is another objective of the present invention to provide a method for manufacturing the case for a secondary battery

Accordingly, to achieve the first objective, there is provided a case for a secondary battery which comprises: a pan having a space for accommodating a battery main body and an opening at the upper side thereof; a first bonding portion extended along the edge of the pan; a cover portion extended from the upper portion of one side of the pan for closing the opening of the pan by being folded onto the pan; and a second bonding portion extended along the edge of the cover portion and correspondingly attached to the first bonding portion when folded onto the pan.

It is preferable in the present invention that the pan, the first bonding portion, the cover portion, and the second bonding portion are integrally formed.

It is also preferable in the present invention that the first bonding portion and the second bonding portion are attached to each other without deformation.

It is yet preferable in the present invention that an emboss is formed at corresponding portions of the first bonding portion and the second bonding portion and the embossed portions of the first bonding portion and the second bonding portion are attached to each other.

It is further preferable in the present invention that concave and convex portions are formed at corresponding portions of the first bonding portion and the second bonding portion along the edge thereof and the concave and convex portions of the first bonding portion and the second bonding portion are attached to each other.

According to another aspect of the present invention, there is provided a case for a secondary battery which comprises: a pan having a space for accommodating a battery main body and an opening at the upper side thereof; a first bonding portion extended along the edge of the pan; a cover portion formed separately from the pan for closing the opening of the pan; and a second bonding portion extended along the edge of the cover portion and correspondingly attached to the first bonding portion.

To achieve the second objective, there is provided a method for manufacturing a case for a secondary battery which comprises the steps of: sectioning a plate material for the case to form a pan and a cover portion on the plate material; molding the material to form the pan; and severing the material according to each section of the plate material preparing a case material in a plate state: setting a plurality of sections on the case material for forming a pan of a battery main body, a gas receiving portion disposed at a side surface of the pan of the battery main body, a path connecting between the pan of the battery main body and the gas receiving portion, and a cover portion covering the pan of the battery main body and the gas receiving portion together; forming the pan of the battery main body, the gas receiving portion, and the path by molding the case material; and severing the case material according to each section.

It is preferable in the present invention that the molding of the material is performed by a pressing process.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objectives and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. 1 is an exploded perspective view illustrating a secondary battery having a case according to a preferred embodiment of the present invention;

FIG. 2 is a plan view of the secondary battery of FIG. 1 in an assembled state;

FIG. 3 is an exploded perspective view illustrating a secondary battery having a case according to another preferred embodiment of the present invention;

FIG. 4 is a plan view of the secondary battery of FIG. 3 in an assembled state;

FIG. 5 is a perspective view for explaining a method for manufacturing the case of the secondary battery shown in FIG. 1; and

FIGS. 6 and 8 are sectional views taken along the lines VI—VI and VIII—VIII of FIG. 4 and

FIG. 7 is a sectional view taken along the line VII—VII of FIG. 2, respectively.

DETAILED DESCRIPTION OF THE INVENTION

FIG. 1 shows a case of a secondary battery according to a preferred embodiment of the present invention. Referring to the drawing, the secondary battery includes a battery main body 4 for generating current, in which an anode plate 1, a cathode plate 2 and a separator 3 are stacked, and a case 10 for housing the battery main body 4. The battery main body 4 can have a different structure according to the type of lithium secondary battery, for example, a lithium ion battery, a lithium polymer battery, and a plastic lithium ion battery. One end of an electrode terminal 5 functioning as an electrical passage to the outside is connected to each electrode plate of the battery main body 4 when the battery main body 4 is coupled to the case 10 forming a seal. The other end of the electrode terminal 5 is exposed to the outside.

According to the present invention, the case 10 includes a pan 11 where the battery main body 4 is received, a first

bonding portion 12 which is a flange along the edge of the pan 11, a cover portion 15 which is to be folded onto the pan 11 to close the opening of the pan 11, and a second bonding portion 14 which is extends along the edge of the cover portion 15 and attached to the first bonding portion 12 when the cover portion is folded onto the pan 11. The pan 11 is a cubic space for accommodating the battery main body 4 and has an opening only at the upper surface thereof. The cover portion 15 is an extended flange on one side of the pan 11 and can close the pan 11 when folded.

The pan 11, the first bonding portion 12, the cover portion 15, and the second bonding portion 14 are integrally formed. The battery main body 4 is inserted in the pan 11 through the opening. As shown in the drawing, the first bonding portion 12 and the second bonding portion 14 form one rectangular flange when the cover portion 15 is not folded onto and does not close the pan 11. The cover portion 15 closes the upper opening of the pan 11 after the battery main body 5 is inserted in the pan 11. The first bonding portion 12 and the second bonding portion 14 can be bent 90° after being bonded together.

FIG. 2 is a plan view showing the secondary battery of FIG. 1 in an assembled state. Referring to the drawing, after the battery main body 4 is inserted into the pan 11, the electrode terminal 5 connected to each electrode plate (not shown) of the battery main body 4 are exposed outside the case 10 to a predetermined length and the cover portion 15 closes the pan 11. The hatched area 21 in the drawing shows the area where the first and second bonding portions 12 and 14 are coupled to each other. Here, since no additional bonding portion is needed for the portion where the cover portion 15 extends from the pan 11, the ratio of occupancy of the battery main body 4 to the total volume of the case 10 increases. Thus, battery efficiency per unit volume is improved in the secondary battery.

FIG. 3 shows a case for a secondary battery according to another preferred embodiment of the present invention. Referring to the drawing, the secondary battery, as in the secondary battery shown in FIG. 1, includes a battery main body 4 for generating current, in which an anode plate 1, a cathode plate 2 and a separator 3 are stacked, and a case 30 for sealing the battery main body 4. Here, the case 30 includes a pan 31 and a cover portion 35 separately manufactured to cover the opening of the pan 31. The pan 31 is rectangular. The pan 31 has a flange as a first bonding portion 32. The cover portion 35 is a plate capable of closing the opening of the pan 31 after the battery main body 4 is inserted into the pan 31. A second bonding portion 34 is a marginal area of the cover portion 35 and the second bonding portion 34 is attached to the first bonding portion 32. The pan 31 and the cover portion 35 can be manufactured by a molding process such as metal molding of plate material for the case.

FIG. 4 is a plan view showing the secondary battery of FIG. 3 in an assembled state. Referring to the drawing, the battery main body 4 is inserted into the pan 31 and the cover portion 35 covers the pan 31 in a state in which the electrode terminals 5 connected to the respective electrode plates (not shown) of the battery main body 4 are exposed outside the case 30 to a predetermined length. The hatched area 41 of the drawing indicates a portion where the first bonding portion 32 and the second bonding portion 34 are attached to each other. Here, to increase the bonding strength between the first bonding portion 32 and the second bonding portion 34, the pan 31 and the cover portion 35 can be manufactured using different materials and in different thicknesses.

The case for the secondary battery having the above structure may be manufactured as follows.

A metal plate is molded to form the pan 11 (31) and the first bonding portion 12 (32), and the second bonding portion 14 (34) at the cover portion 15 (35). Here, the cover portion 15 (35) and the second bonding portion 14 (34) are formed integrally with the pan 11 (31) and the first bonding portion 12 (32) or separately therefrom. The battery main body 4 is inserted into the pan 11 (31) and the electrode terminals 5 connected to the battery main body 4 are arranged to be exposed outward. The first bonding portion 12 (32), which is a flange of the pan 11 (31), and the second bonding portion 14 (34), which is a marginal area of the cover portion 15 (35), are attached to each other, forming a closed space inside the case 10 (30). The above manufacturing method is schematically described. In an actual case, a step for storing gas generated when the battery main body 4 is charged or discharged in the gas receiving portion, which will be described with reference to FIG. 5.

FIG. 5 is a view for explaining a method for forming the secondary battery case shown in FIG. 1 in large quantities using a plate material.

Referring to the drawing, a plate material 51 is sectioned as indicated by the dotted lines and a unit case 54 can be formed per section. Each unit case 54 has a pan 52 and a gas receiving portion 55 of the battery main body. The gas generated in the battery pan 52 can be exhausted to the gas receiving portion 55 through a path 56. When a battery is manufactured including a battery main body in a battery case, the battery main body is contained in the battery pan 52. Next, a cover portion 53 covers over both the battery pan 52 and the gas receiving portion 55, forming a seal. At this time, the path 56 is kept in an open state. When the battery main body charges and discharges, the gas generated from the battery main body flows toward the gas receiving portion 55 through the path 56 from the battery pan 52. When the gas is gathered in the gas receiving portion 55, the path 56 is closed. Finally, the gas receiving portion 55 is removed in a severing process.

The unit case 54, as shown in FIG. 5, can be formed by severing the material along the line indicated by a dot-dash-dot line after the battery main body pan 55, the gas receiving portion 55, and the path 56 are formed per section through a predetermined process such as in a press.

In another embodiment, a separately manufactured battery main body is inserted in the pan 52 before the material 51 is severed along a dashed line extending in a lengthwise direction of the material 51 and along a dashed line extending in a widthwise direction thereof. Next, the cover portion 53 is folded concurrently so that the cover portion 53 is closely coupled to the pan 52. Next, the battery main body is charged/discharged and the path 56 is closed. Finally, the material 51 is severed in a lengthwise direction so that the gas receiving portion 52 is removed and simultaneously each unit case can be separated.

In yet another example, separately from the severance of the portions indicated by the dotted lines, the portion where the pan 52 is formed and the portion where the cover portion 53 is formed are severed and separated from each other and thus the battery case shown in FIG. 3 can be manufactured.

FIGS. 6 and 8 are sectional views taken along the lines VI—VI and VII—VII of FIG. 4 and FIG. 7 is a sectional view taken along the line VII—VII of FIG. 2. These drawings show methods of attaching the first bonding portion 12 (32) to the second bonding portion 14 (34).

FIG. 6 shows a surface bonding method, in which the first bonding portion 12 (32) and the second bonding portion 14 (34) are attached to each other without deformation.

Although various attaching methods can be used, arc welding is preferred.

FIG. 7 shows an embossing method, in which an embossed portion is formed at the corresponding portions of the first bonding portion 12 (32) and the second bonding portion 14 (34) to increase the bonding strength.

FIG. 8 shows a linear method, in which concave and convex portions are formed at the corresponding portions of the first bonding portion 12 (32) and the second bonding portion 14 (34). This method also increases the bonding strength.

As described above, in secondary batteries according to the present invention, the case having a pan for accommodating a battery main body, a cover portion for closing the pan, and a bonding portion extended along the edge of the pan and the cover portion can be easily manufactured. Also, since the bonding portions can be attached by one of a surface method, an embossing method, and a linear method, mass production of the case is possible and the bonding portions are connected together firmly.

What is claimed is:

1. A secondary battery and a case comprising:

a secondary battery having a main body and first and second projecting electrode terminals; and

a case including:

a pan having a space accommodating the main body of the secondary battery;

a first bonding flange extending along an edge of the pan;

a cover extending from one side of the pan, closing the opening of the pan, and folded into the pan; and

a second bonding flange extending along an edge of the cover and correspondingly bonded to the first bonding flange with the electrode terminals passing between the first and second bonding flanges and exposed outside the case.

2. The secondary battery and case as claimed in claim 1, wherein the pan, the first bonding flange, the cover, and the second bonding flange are a single piece of material.

3. The secondary battery and case as claimed in claim 1, wherein the first bonding flange and the second bonding flange are bonded to each other without their deformation.

4. The secondary battery and case as claimed in claim 1, including embossed portions in the first bonding flange and the second bonding flange in mutual engagement.

5. The secondary battery and case as claimed in claim 1, including concave and convex portions in the first bonding flange and the second bonding flange in mutual engagement.

6. A secondary battery and a case comprising:

a secondary battery having a main body and first and second projecting electrode terminals; and

a case including:

a pan having a space accommodating the main body of the secondary battery;

a first bonding flange extending along an edge of the pan;

a cover not hingedly connected to the pan and closing the opening of the pan; and

a second bonding flange extending along an edge of the cover and correspondingly bonded to the first bonding flange with the electrode terminals passing between the first and second bonding flanges and exposed outside the case.

7. The secondary battery and case as claimed in claim 6, wherein the first bonding flange and the second bonding flange are bonded to each other without their deformation.

8. The secondary battery and case as claimed in claim 6, including embossed portions in the first bonding flange and the second bonding flange in mutual engagement.

9. The secondary battery and case as claimed in claim 6, including concave and convex portions in the first bonding flange and the second bonding flange in mutual engagement.

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US006242131B1

(12) **United States Patent**
Noh

(10) **Patent No.: US 6,242,131 B1**
(45) **Date of Patent: Jun. 5, 2001**

(54) **CASE OF LITHIUM SECONDARY BATTERY BASED ON A POLYMER COATED ALUMINUM MATERIAL**

(75) Inventor: **Hyung-gon Noh**, Seoul (KR)

(73) Assignee: **Samsung SDI Co., Ltd.**, Kyungki-do (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/384,978**

(22) Filed: **Aug. 30, 1999**

(30) **Foreign Application Priority Data**

Aug. 29, 1998 (KR) 98-35425

(51) **Int. Cl.**[7] **H01M 2/08**
(52) **U.S. Cl.** **429/185**; 429/163; 429/176
(58) **Field of Search** 429/176, 213, 429/185, 163

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Primary Examiner—Stephen Kalafut
Assistant Examiner—Mark Ruthkosky
(74) *Attorney, Agent, or Firm*—Leydig, Voit & Mayer, Ltd.

(57) **ABSTRACT**

The present invention provides a lithium secondary battery for surrounding and hermetically sealing a battery body which generates current, comprising: a first copolymer layer which is the innermost layer for surrounding and hermetically sealing the battery body and is formed of poly (ethylene-co-acrylic acid) (EAA); an aluminum (Al) layer formed on the first copolymer layer; and a first nylon layer which is the outermost layer formed on the Al layer. The case can improve the overall moldability and interlayer adhesiveness and can effectively prevent leakage of an electrolytic solution, thereby increasing the battery reliability.

7 Claims, 3 Drawing Sheets

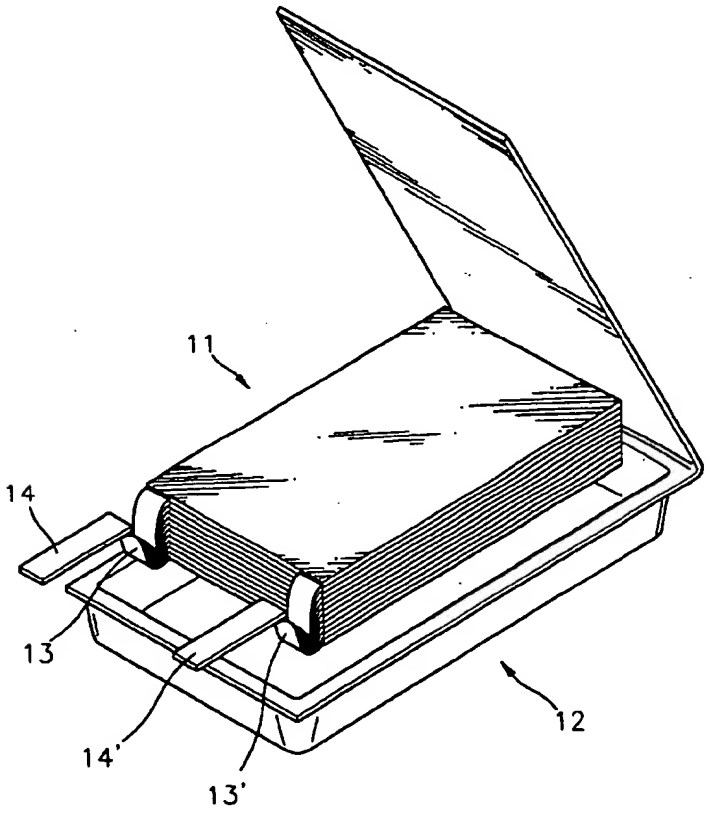


FIG.1

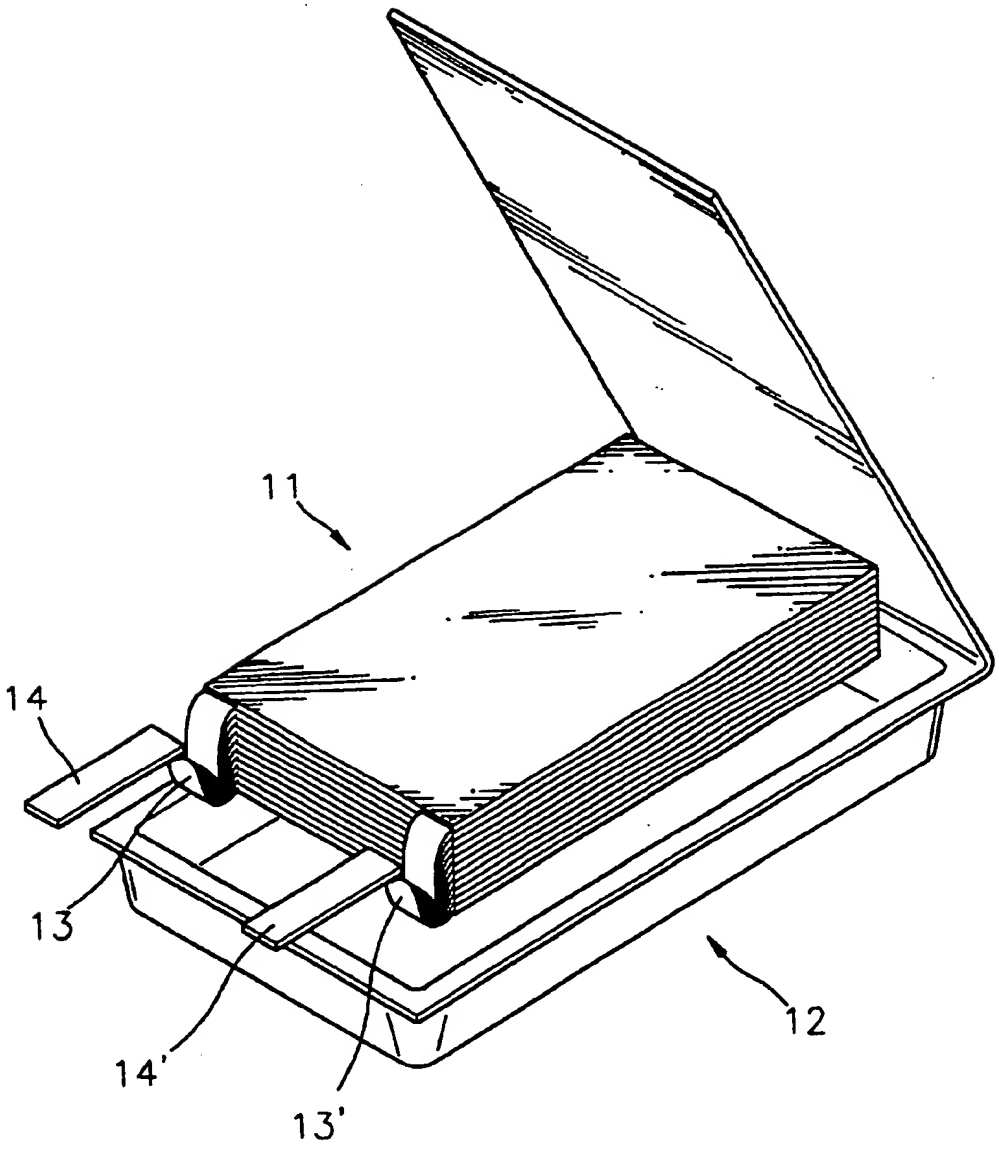


FIG.2

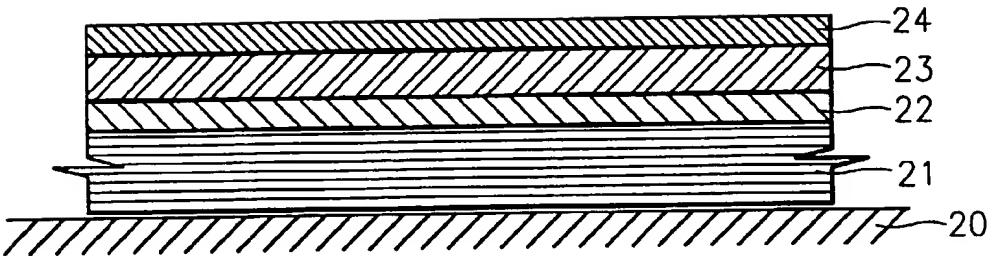


FIG.3

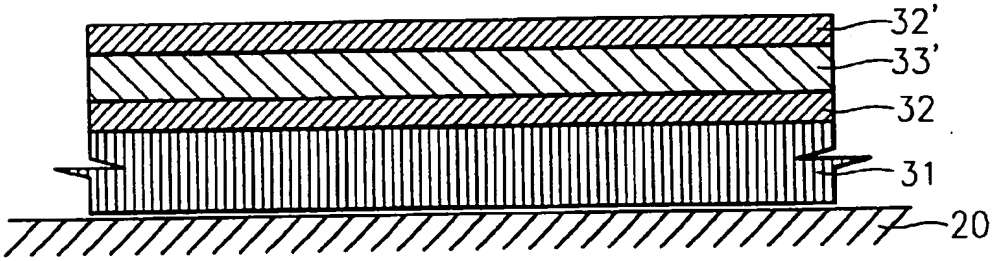


FIG.4

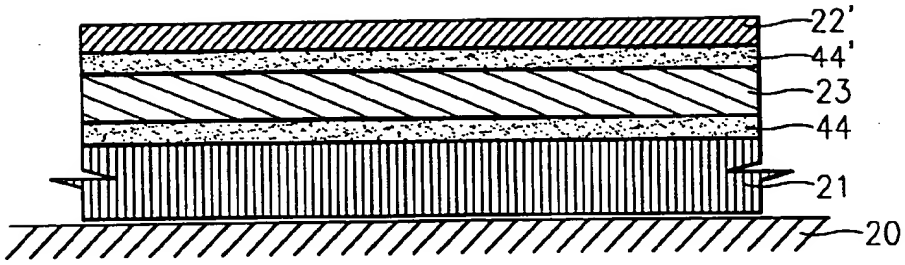


FIG.5

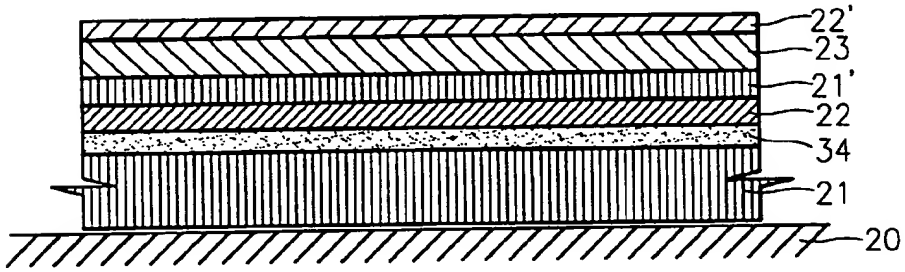
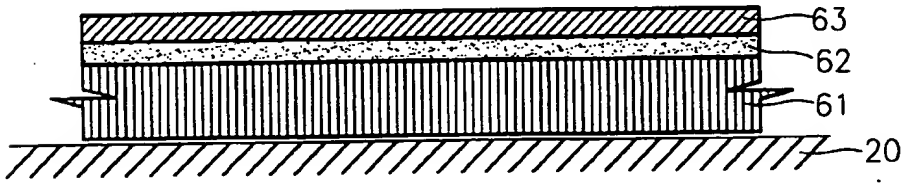


FIG.6



CASE OF LITHIUM SECONDARY BATTERY BASED ON A POLYMER COATED ALUMINUM MATERIAL

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a lithium secondary battery, and more particularly, to the case of a lithium secondary battery which hermetically seals and surrounds a battery body generating a current.

2. Description of the Related Art

As electronic devices such as camcorders, cellular phones or notebook type computers have been made smaller in size and lighter in weight, there has been considerable demand for small and lightweight secondary batteries with high energy density which can be used for these electronic devices. As such, a lithium secondary battery has been attracting attention as a high energy density battery. According to the kind of electrolyte used, a lithium secondary battery can be classified into a lithium ion battery which uses a liquid electrolyte and a lithium ion polymer battery which uses a solid electrolyte.

The lithium ion polymer battery includes a battery body for generating current, which is made by stacking a cathode, an anode and a separator. An electrode terminal serving as an electrical path to the outside is connected to the battery body. Parts of the battery body and the electrode terminal are hermetically sealed in an insulating case. The case of the lithium ion polymer battery hermetically seals the battery body such that thermal adhesive material layers, an innermost layer of the battery body, are adhered to each other.

FIG. 1 is an exploded perspective view showing an example of a conventional lithium ion polymer battery. Referring to FIG. 1, the lithium ion polymer battery includes a battery body 11 having a cathode plate, an anode plate and a separator, and a case 12 surrounding the battery body 11, heretically sealing the body. Electrode tabs 14 and 14' serving as an electrode path for inducing the current generated in the battery body 11 to the outside are installed such that a predetermined length of them is exposed outside the case material 12.

The case 12 is made of an outer material such as an insulating film having a stacked structure, as shown in FIG. 2.

Referring to FIG. 2, the outer material is formed such that a thermal adhesive material layer 21, an innermost layer of a battery body 20, has an aluminum (Al) layer 22, a polyethylene layer 23, and a polyester layer 24 sequentially deposited thereon. Here, the thermal adhesive material layer 21 is formed of SURLYN (Dupont Inc.) obtained by adding Na, K, Mg or Zn to poly(ethylene-co-acrylic acid). The Al layer 22 on the thermal adhesive material layer 21 prevents permeation of moisture and loss of an electrolytic solution. The polyethylene layer 23 strengthens the functions of an outermost layer and improves adhesiveness. The polyester layer 24, the outermost layer, protects the battery against external shock.

The case 12 formed of the above-described outer material hermetically seals the battery such that the battery body 11 is inserted into the case 12, with only parts of the electrode taps 14 and 14' being exposed, and then the case is folded in half. Then, heat and pressure are applied to the case 12 to hermetically seal the battery such that thermally adhesive materials of the edges in the upper and lower portions of the case 12 are adhered to each other.

As described above, the case is bonded by thermally adhering parts of the innermost layer surrounding the battery body 20. However, since the outer material of the conventional lithium secondary battery is relatively thin and the Al layer 22 is particularly thin, that is, about 9 μm, it is not easy to fabricate the outer material of the conventional lithium secondary battery. Also, the polyester layer 24, the outermost layer, is susceptible to defects during molding, such as cracking.

Further, in the outer material of the conventional lithium secondary battery, when the innermost layer is thermally adhered, the adhesion efficiency may be poor, depending on a slight change in processing conditions including pressure, temperature and time, which causes leakage of the electrolytic solution in the lithium secondary battery.

SUMMARY OF THE INVENTION

To solve the above problems, it is an objective of the present invention to provide a case of a lithium secondary battery having an improved reliability by enhancing its moldability.

To accomplish the above objective, the present invention provides a case of a lithium secondary battery for surrounding and hermetically sealing a battery body which generates current, comprising:

a first copolymer layer which is the innermost layer for surrounding and hermetically sealing the battery body and is formed of poly(ethylene-co-acrylic acid) (EAA);

an aluminum (Al) layer formed on the first copolymer layer; and

a first nylon layer which is the outermost layer formed on the Al layer.

Here, the Al layer has a thickness of at least 50 μm. Also, a second nylon layer is further formed between the first copolymer layer and the Al layer.

According to another aspect of the present invention, a first polyethylene layer is formed between the first copolymer layer and the Al layer and a second polyethylene layer is formed between the Al layer and the first nylon layer.

According to still another aspect of the present invention, a polyethylene layer, a second nylon layer and an EAA layer are sequentially deposited between the first copolymer layer and the Al layer.

Also, the objective of the present invention can be accomplished by a case of a lithium secondary battery for surrounding and hermetically sealing a battery body which generates current, comprising:

a polypropylene layer which is the innermost layer for surrounding and hermetically sealing the battery body;

an Al layer formed on the polypropylene layer; and

a polyester layer which is the outermost layer formed on the Al layer.

The case of the lithium secondary battery having the above-described layer structure employs a solid electrolyte, which obviate a possibility of electrolytic solution leakage. Thus, the case is useful for a battery which does not need to be molded.

The Al layer preferably has a thickness of 30 μm or more. An Al layer having a thickness of less than 50 μm is not preferred because the moldability of the Al layer is poor.

BRIEF DESCRIPTION OF THE DRAWINGS

The above objectives and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. 1 is an exploded perspective view showing an example of a conventional lithium ion polymer battery;

FIG. 2 is a cross-sectional view showing the case of a conventional lithium ion polymer battery; and

FIGS. 3 through 6 are cross-sectional views showing a case of a lithium secondary battery according to the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 3, a case of a lithium secondary battery according to the present invention is formed of a poly (ethylene-co-acrylic acid) (EAA) layer **31** as an innermost layer for surrounding and hermetically sealing a battery body **20**. A first nylon layer **32**, an Al layer **33'** and a second nylon layer **32'** are sequentially formed thereon. The case hermetically seals the battery body **20** by thermally adhering overlapping ends of the EAA layer **31** to each other.

The first nylon layer **32** increases the adhesiveness between the EAA layer **31** and the Al layer **33'** and allows the Al layer **33'** to be smoothly molded. The Al layer **33'** prevents permeation of moisture and loss of an electrolytic solution and is formed to a thickness of at least 50 μm so as to facilitate molding of the case. If the thickness of the Al layer **33** is less than 30 μm, the moldability is unfavorably degraded.

The second nylon layer **32'** as the outermost layer is a protective layer for preventing cracks from being generated on the outer surface of the battery and facilitates the molding of the case.

Preferably, the EAA layer **31** has a thickness in the range of 15 to 55 μm, the first nylon layer **32** has a thickness in the range of 15 to 25 μm, the Al layer **33** has a thickness in the range of 30 to 50 μm, and the second nylon layer **32'** has a thickness in the range of 10 to 50 μm. When the respective layers have thicknesses in the above-described ranges, the battery exhibits the highest reliability.

Also, although not shown, the adhesiveness between layers can be further enhanced by interposing a polyurethane layer between the layers.

FIGS. 4 and 5 show cases according to another aspect of the present invention. Here, the same reference numerals as those of FIG. 3 denote equivalent layers.

Referring to FIG. 4, an Al layer **23** and a nylon layer **22'** are deposited on an EAA layer **21** coupled to a battery **20**. Also, a first polyethylene layer **44** is located between the EAA layer **21** and the Al layer **23**, and a second polyethylene layer **44'** is located between the Al layer **23** and the nylon layer **22'**. The first and second polyethylene layers **44** and **44'** increase the adhesiveness between the respective layers and facilitate molding of the Al layer **23**.

Preferably, the EAA layer **21** has a thickness in the range of 20 to 45 μm, the first polyethylene layer **44** has a thickness in the range of 5 to 15 μm, the Al layer **23** has a thickness in the range of 35 to 55 μm, the second polyethylene layer **44'** has a thickness in the range of 5 to 15 μm, and the nylon layer **22'** has a thickness in the range of 5 to 15 μm.

Referring to FIG. 5, the case is constructed such that a polyethylene layer **34**, a first nylon layer **22** and a second EAA layer **21'** are sequentially arranged on a first EAA layer **21** as the innermost layer coupled to the battery body **20**, for preventing leakage of an electrolytic solution and for increasing the moldability of the case.

An Al layer **23** and a second nylon layer **22'** as the outermost layer are provided on the second EAA layer **21'**.

In the case having the aforementioned structure, preferably, the first EAA layer **21** has a thickness in the range of 20 to 45 μm, the polyethylene layer **34** has a thickness in the range of 5 to 15 μm, the first nylon layer **22** has a thickness in the range of 5 to 15 μm, the second EAA layer **21'** has a thickness in the range of 5 to 15 μm, the Al layer **23** has a thickness in the range of 30 to 50 μm, and the second nylon layer **22'** has a thickness in the range of 5 to 25 μm.

The case of the lithium secondary battery shown in FIG. 6 is preferably formed of a material for hermetically sealing a gel-type battery body employing a solid separator and a separate molding process is not necessary.

Referring to FIG. 6, the case is constructed such that an Al layer **62** and a polyester layer **63** are sequentially formed on a polypropylene layer **61** as the innermost layer coupled to the battery body **20**. In particular, the polyester layer **63** is not specifically restricted but is preferably formed of polyethyleneterephthalate.

In the case having the aforementioned structure, preferably, the polypropylene layer **61** has a thickness in the range of 10 to 80 μm, the Al layer **62** has a thickness in the range of 15 to 30 μm, and the polyester layer **63** has a thickness in the range of 20 to 50 μm.

As described above, the case of the lithium secondary battery according to the present invention includes an EAA layer as the innermost layer, a nylon layer as the outermost layer, and an Al layer interposed therebetween and having a thickness of at least 50 μm. The case can improve the overall moldability and interlayer adhesion and can effectively prevent leakage of an electrolytic solution, thereby increasing the battery reliability.

Also, since the case shown in FIG. 6 hermetically seals a gel-type battery body, it is useful for a battery which does not need to be separately molded.

What is claimed is:

1. A case of a lithium secondary battery for surrounding and hermetically sealing a battery body which generates current, the case comprising:

a first copolymer layer for surrounding and hermetically sealing a battery body, the layer being poly(ethylene-co-acrylic acid) (EAA);

an Al layer on the first copolymer layer; and

a nylon layers which is the outermost layer, on the Al layer.

2. The case according to claim **1**, wherein the Al layer has a thickness of at least 30 μm.

3. The case according to claim **1**, further comprising another nylon layer between the first copolymer layer and the Al layer.

4. The case according to claim **1**, further comprising a first polyethylene layer between the first copolymer layer and the Al layer and a second polyethylene layer between the Al layer and the nylon layer.

5. The case according to claim **1**, wherein a polyethylene layer, another nylon layer and an EAA layer, are sequentially arranged between the first copolymer layer and the Al layer.

6. A case of a lithium secondary battery for surrounding and hermetically sealing a battery body which generates current, the case comprising:

a polypropylene layer for surrounding and hermetically sealing a battery body;

an Al layer on the polypropylene layer; and

a polyethyleneterephthalate layer, the outermost layer, on the Al layer.

7. The case according to claim **6**, wherein the Al layer has a thickness in a range of 5 to 30 μm.

* * * * *

US006218041B1

(12) **United States Patent**
Barbier et al.

(10) **Patent No.: US 6,218,041 B1**
(45) **Date of Patent: Apr. 17, 2001**

(54) **BATTERY UNIT AND A PORTABLE BATTERY-OPERATED DEVICE INCLUDING SUCH A BATTERY UNIT**

(75) Inventors: **Fabrice R. H. Barbier**, Saint Saturnin; **Vincent Cachard**, Le Mans; **Alain De Larminat**, Saumur, all of (FR)

(73) Assignee: **U.S. Philips Corporation**, New York, NY (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/185,003**

(22) Filed: **Nov. 3, 1998**

(30) **Foreign Application Priority Data**

Nov. 5, 1997 (EP) 97402645

(51) **Int. Cl.**[7] **H01M 2/02**; H01M 2/10; H01M 2/06

(52) **U.S. Cl.** **429/96**; 429/121; 429/162; 429/163

(58) **Field of Search** 429/124, 127, 429/162, 163, 96, 97, 99, 100, 121

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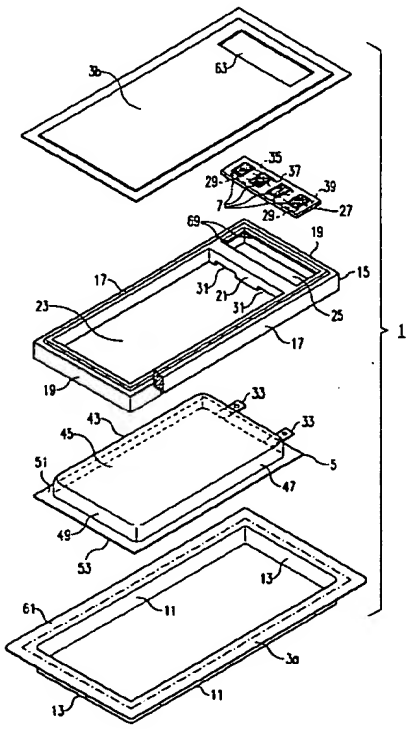
Primary Examiner—Carol Chaney
Assistant Examiner—Jonathan Crepeau

(57) **ABSTRACT**

A battery unit may be used in devices and appliances in which a particularly light and flat battery is desired, such as in particular portable telephones. The battery unit has a housing in which one or several cells generating electricity are provided, such as, for example, a lithium polymer cell. The battery unit is provided with output contacts by means of which the cells can be electrically connected to an appliance, for example by means of resilient contacts present in the appliance. The battery unit is further provided with a housing having a number of external walls such as an upper wall, a bottom wall, and side walls. The housing is internally provided with a substantially flat frame with flat ribs for the purpose of reinforcement and one or several recesses between them. The cell or cells is (are) provided in a recess, possibly in several respective recesses, of the frame. An external envelope of thin metal plating is provided around the frame so that the entire assembly is well protected and nevertheless has minimized dimensions and a minimized mass.

11 Claims, 3 Drawing Sheets



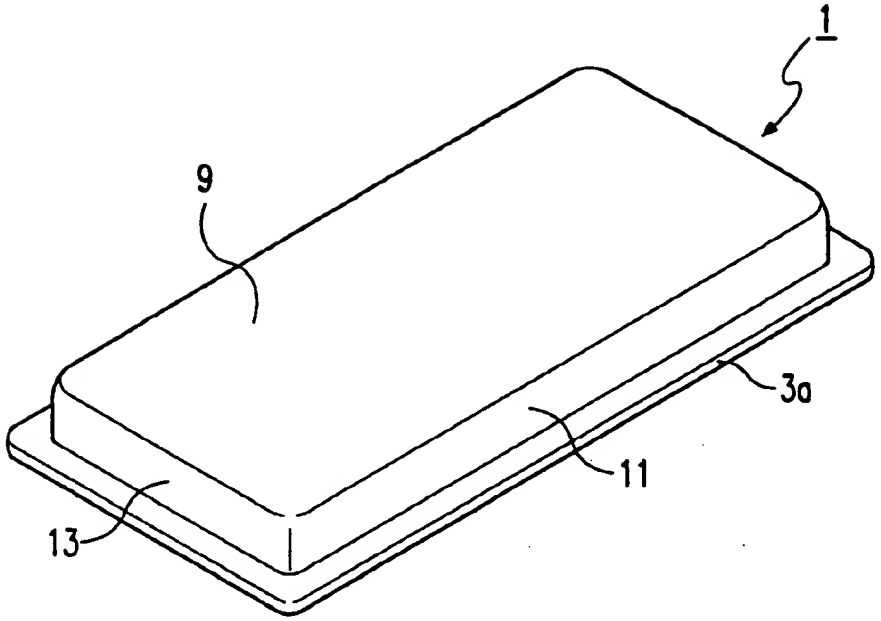


FIG. 1

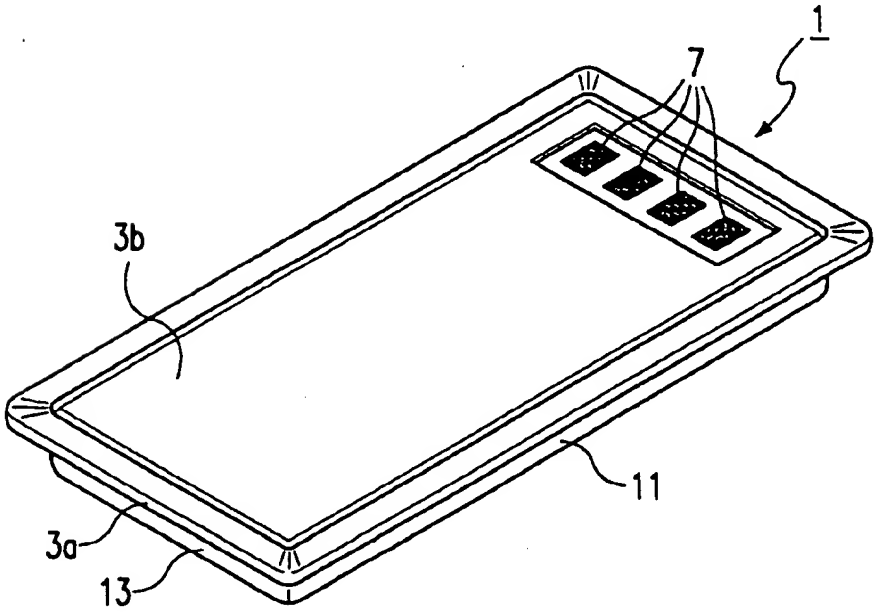


FIG. 2

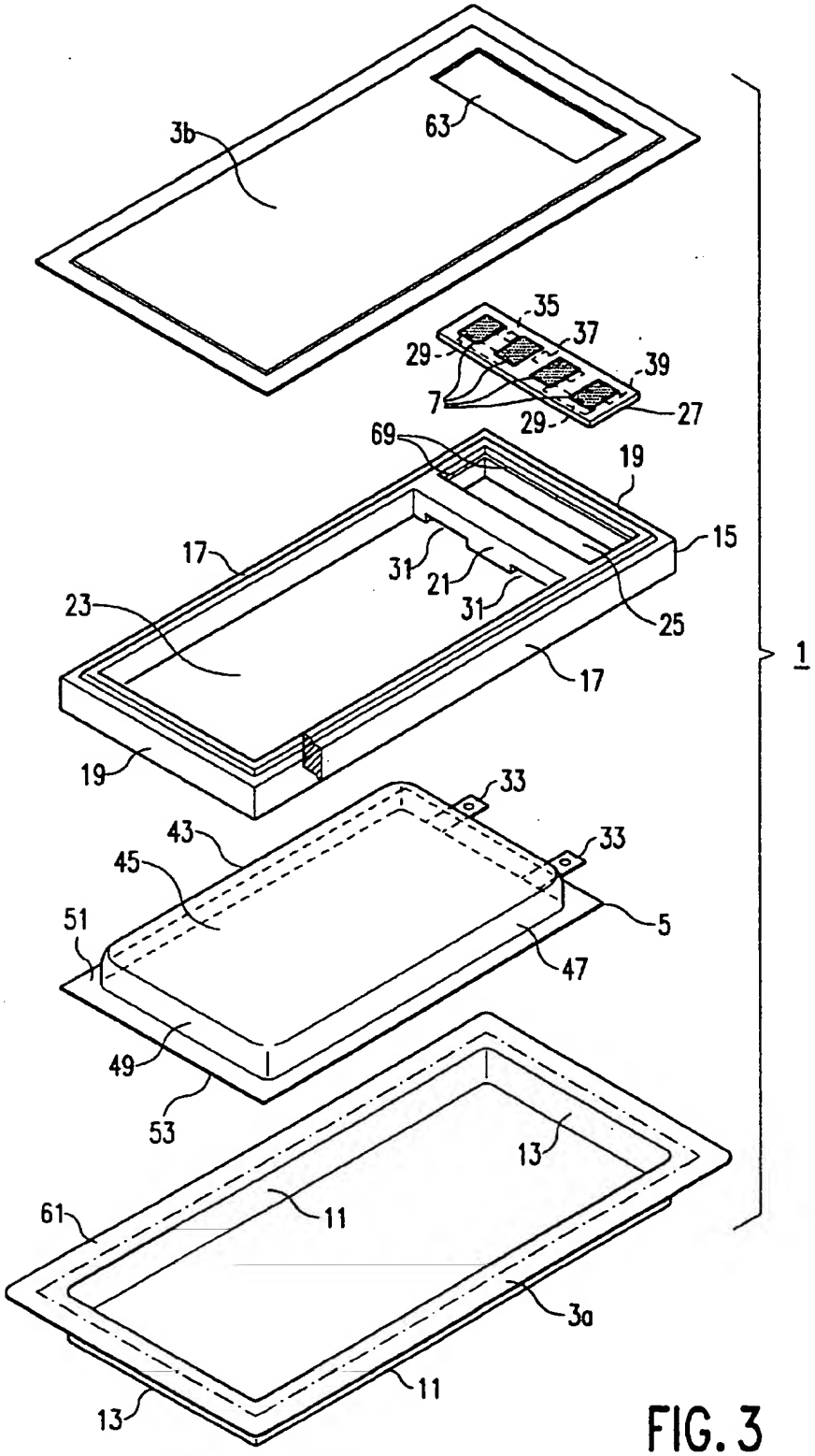

3b
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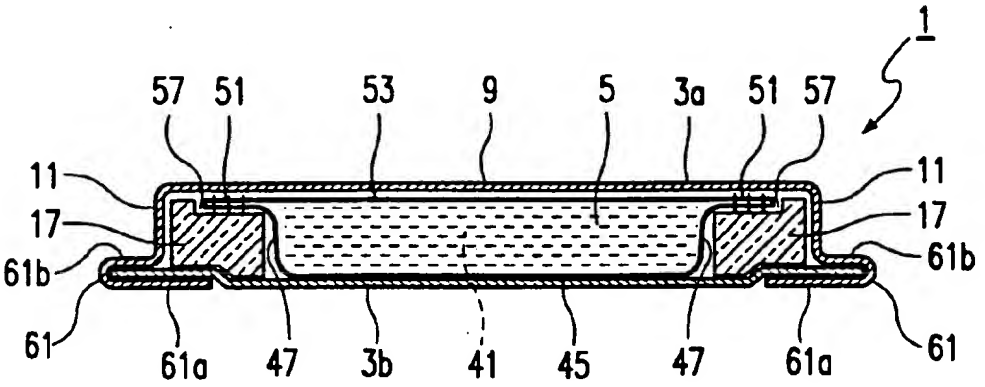
FIG. 3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61a
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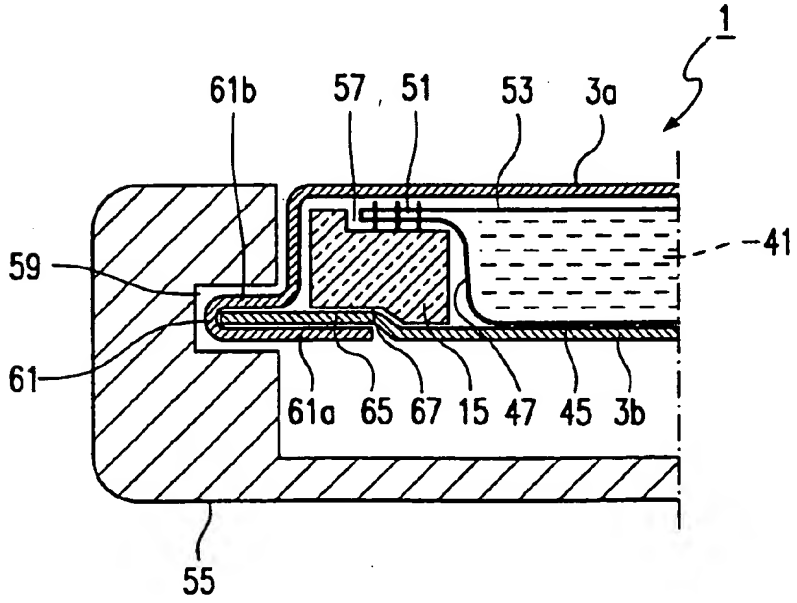
61b

FIG. 4


1
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3a
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61
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61a
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67
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47
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3b
55

FIG. 5

BATTERY UNIT AND A PORTABLE BATTERY-OPERATED DEVICE INCLUDING SUCH A BATTERY UNIT

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a battery unit for use in devices and appliances such as portable telephones, which battery unit is provided with a housing, with one or more cells which generate energy, with output contacts for connecting the cells to an appliance, and with external walls comprising an upper wall, a lower wall and side walls. Such a battery unit is known, for example, from its use in various types of portable telephones.

The present invention further relates to a portable battery-operated device including such a battery unit.

2. Description of the Related Art

Manufacturers continuously strive to make battery-operated devices of various kinds, in particular portable devices, as light and as small as possible. It is accordingly essential for the battery used to have the greatest possible capacity accompanied by the smallest possible dimensions and the smallest possible mass. Reference is made in this connection to European patent application 96402738.7 filed earlier by applicant but not yet published, which is deemed to be incorporated in its entirety in the present application by reference. The portable telephone described in said earlier application is provided with a flat, substantially rectangular battery unit which is provided adjacent its long sides with ridges and/or grooves for guiding the battery unit into associated portions of the housing of the portable telephone. The battery unit is provided with an external envelope which at the same time serves as an external part of the telephone. The external envelope is substantially entirely closed and is provided with a number of output contacts at the area of one of the external walls, which contacts achieve an electrical connection with corresponding contact elements of the telephone after the unit has been inserted into the portable telephone.

SUMMARY OF THE INVENTION

The invention has for its object to provide a battery unit of the kind mentioned in the opening paragraph which has a small mass and/or which is constructed such that it can be easily and simply assembled and has the required sturdiness for complying with the various operational requirements. To achieve this, the housing is provided with a substantially flat frame with flat ribs and one or several recesses therebetween, said one or several cells is/are provided in one or several recesses of the frame, and said walls form part of an external envelope which comprises portions of thin metal plating provided around the frame.

The presence of the frame provides the desired sturdiness of the housing. The recesses present between the ribs can be used for accommodating the various internal components of the battery unit and for fastening external components such as the external walls of the housing. A result of this is also that the external walls may be thin, because the sturdiness of the housing is mainly supplied by the frame.

In a preferred embodiment the battery unit is provided with a printed wiring ("printed circuit board" or PCB), with said output contacts, and with connection contacts for connecting said one or several contacts to the PCB, the PCB is present in a recess of the frame, separated from the recess in which said one or several cells is/are present by a separation rib of the frame, and said separation rib is provided with local depressions for the passage of conductors connecting said one or several cells to the PCB within the thickness of the frame. The electric cells and the PCB do not interfere with one another and cannot damage one another because they are present in different recesses of the frame, separated by one or several separation ribs of the frame. Nevertheless, the electric cells can be connected to the PCB by means of conductors which are passed through via the local recesses while remaining within the thickness of the frame.

Preferably, the PCB is in addition provided with electronic circuit elements for the protection and/or control of the operation of the battery unit. In that manner the necessary electronic components can be provided on the PCB and within the space available inside the frame so as to ensure that the battery, in particular the electric cells, is (are) not damaged. Further electronics may also be present, for example for monitoring the amount of charge of the battery, for controlling the charging of the battery, and the like.

In an embodiment of the invention, each cell consists of a lithium polymer cell whose general shape is rectangular, said lithium polymer cell comprises a two-part foil envelope consisting of a trough-shaped part by means of heat and having a bottom, vertical walls and a circumferential flange which merges into the vertical walls and which is parallel to the bottom, and a flat lid provided on the circumferential flange, and the lid and the circumferential flange are united to one another by means of heat sealing. Lithium polymer is a promising technology for future portable batteries and the integration thereof in portable devices such as portable telephones, which will contribute to flat constructions, low cost levels, safety, and freedom of design. The invention is eminently suitable for building thin, flat batteries with lithium polymer cells. A lithium polymer cell is manufactured as a stack, or from layers which are electrically interconnected in parallel or, depending on the application, in series. This stack is subsequently hermetically closed in an envelope so as to prevent moisture penetrating into the cell and damaging it. In the present embodiment of the invention, the envelope of the electric cell comprises a foil envelope in two parts. The one part is shaped by means of heat into a shallow trough in which the stack is placed. A flat, outwardly directed flange surrounds the trough. A flat piece of foil is placed on the trough, acting as a lid and covering the trough entirely, including also the circumferential flange. Then the lid and the flange of the trough are connected to one another by means of heat sealing at the circumference of the foil envelope thus formed. To render possible an electrical connection of the cell to the external world, two or more electrical conductors such as, for example, conductor strips, may be passed between the lid and the flange to the exterior. During the heat-sealing process, these conductors may be fused into the melting foil material of the envelope. After the heat-sealing operation, accordingly, a hermetically closed unit packed in a foil envelope has been obtained, which can be placed in a recess of the frame. In an embodiment the frame is provided with stepped circumferential parts, the circumferential edge of the foil envelope extends over the stepped parts of the frame and is disposed within the thickness dimension of the frame. This may also be utilized here for limiting the thickness dimension of the battery unit.

Preferably, in a further embodiment of the invention the external envelope comprises a trough-shaped part with a bottom, vertical walls, and a circumferential flange which merges into the vertical walls and is parallel to the bottom, and a lid, said foil envelope is provided in the trough-shaped part of the external envelope such that the lid of the foil

envelope lies against the bottom of said trough-shaped part, the circumferential flange of the external envelope is bent back over the frame placed therein such that the bent-back portion of said flange covers part of the width of the relevant rib of the frame, said lid of the external envelope is provided over the frame so as to lie with a circumferential edge within the bent-back portion of said flange, and both said bent-back portion and the lid of the external envelope are connected to the frame; A sturdy metal battery unit is created thereby which is nevertheless thin and light and which is provided at its circumference with a circumferential rim which may be used for guiding the battery unit into matching portions of an electrical appliance. If so desired, the plate material of which the external envelope is composed may be provided with local ribs for increasing the strength of the external envelope. In an embodiment, the frame is provided with stepped circumferential parts and the circumferential edge of the lid of the external envelope as well as the bent-back portion extend over the stepped part of the frame and are disposed at least partly within the thickness dimension of the frame. This may be utilized for limiting even further the thickness dimension of the battery unit.

In an interesting embodiment of the invention the external envelope of the battery unit comprises at least one PCB which is connected to the one or more electrical cells. This embodiment uses a PCB as an external part of the housing of the battery unit. this may eliminate the need for any additional PCB within the battery unit, thus further reducing the number of parts and possibly also the outer dimensions and/or the mass of the battery unit.

The invention also relates to a portable battery operated device comprising a battery unit of which the external envelope comprises a trough-shaped part with a bottom, vertical walls, and a circumferential flange which merges into the vertical walls and is parallel to the bottom, and a lid, said foil envelope is provided in the trough-shaped part of the external envelope such that the lid of the foil envelope lies against the bottom of said trough-shaped part, the circumferential flange of the external envelope is bent back over the frame placed therein such that the bent-back portion of said flange covers part of the width of the relevant rib of the frame, said lid of the external envelope is provided over the frame so as to lie with a circumferential edge within the bent-back portion of said flange, and both said bent-back portion and the lid of the external envelope are connected to the frame, the battery unit being disposed to the outside of the device and being inserted with the external flange in a groove present in the device so as to direct the flange to the inside of the device. As the external flange of the external envelope of the battery unit is directed to the inside of the battery operated device, the groove in which this flange is disposed may be accommodated well inwardly also, adding strength to the groove walls.

BRIEF DESCRIPTION OF THE DRAWING

The invention will now be explained in detail, purely by way of example, to which the invention is by no means limited, with reference to an embodiment as shown in the accompanying drawing, in which:

FIG. 1 is a perspective bottom elevation of a lithium polymer battery unit according to the invention provided with four output contacts,

FIG. 2 is a perspective view similar to that of FIG. 1, but now of the upper side of the battery unit of FIG. 1,

FIG. 3 is an exploded view of the battery unit shown in FIG. 2, and

FIG. 4 is a cross-sectional view of the battery unit shown in the preceding Figures, and

FIG. 5 is a partial view in cross section of a portable telephone incorporating the battery unit of the preceding figures on an enlarged scale.

Corresponding parts have been given the same reference numerals in the various Figures.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The various Figures show a battery unit **1** for use in devices and appliances such as telephones. The battery unit is provided with a housing **3***a,b*, **15** with a lithium polymer cell **5** and with output contacts **7** for connecting the battery unit to a device.

The external envelope **3***a,b* of the housing comprises external walls consisting of the upper wall **3***b*, an opposed lower wall **9**, long side walls **11**, and short side walls **13**. The housing is further provided with a generally flat frame **15**, see in particular FIGS. **3** and **4**, with long, generally flat ribs **17**, short ribs **19** connected thereto, and a connecting rib **21**. Between said generally flat ribs, there is a large recess **23** and a smaller recess **25**. The lithium polymer cell **5** is provided in the recess **23** of the frame. Said walls **3***b*, **9**, **11**, and **13** of the external envelope of the housing are formed by portions of thin metal plating which are provided around the frame **15**. The frame may consist of, for example, a synthetic resin, which may be reinforced, and may have a height of approximately 3 mm.

As is apparent especially from FIG. **3**, the battery unit is provided with a support plate **27** provided with a printed wiring circuit. This kind of support plate is generally known in many embodiments and is usually referred to as "printed circuit board" or PCB. The PCB **27** is provided with the output contacts **7** mentioned above. At the opposite, rear side, which is not visible in FIG. **3**, there are connection contacts **29** which serve for the electrical connection of the electric cell **5**. Both the output contacts **7** and the connection contacts **29** are formed as so-called islands on the PCB. These may serve to make contact with resilient contacts of other components or for the fastening of connection wires and the like by means of solder.

The PCB **27** is present in said recess **25** of the frame **15** and is accordingly separated from the recess **23** in which the lithium polymer cell **5** is present by the separation rib **21** of the frame. A satisfactory separation between the PCB and the lithium polymer cell is obtained thereby, so that these two components are securely enclosed within the frame in mutually defined positions. The separation rib **21** is provided with local depressions **31**. The lithium polymer cell **5** is provided with strip-shaped conductors **33** which match these depressions. The depth of the depressions **31** and the thickness of the strip-shaped conductors **33** are so adjusted to one another that the strips **33** lie in the depressions **31** in such a manner that the strips do not project above the thickness of the frame when the lithium polymer cell is provided in the recess **23** of the frame **15**. The strips **33** make contact with the islands **29** of the PCB **27** and, if so desired, are securely connected thereto by means of soldering.

As is diagrammatically shown in FIG. **3**, the PCB **27** is provided with a number of electronic circuit elements, three of which have been given reference numerals: i.e. **35**, **37** and **39**.

Alternatively the PCB **27** could be dispensed with and one of the walls of the external envelope such as the wall **3***b* could constitute a PCB itself or at least part of it could constitute a PCB.

The lithium polymer cell **5** will now be explained in more detail with reference to FIGS. **3** and **4**. The cell is built up in a known manner from a stack of mutually connected layers **41** which in FIG. **4** are indicated very diagrammatically only by means of fully drawn lines. This construction is known per se from the prior art and does not fall within the scope of the invention, so that a detailed description thereof will not be given. Said stack **41** is provided within a foil envelope in a hermetically sealed manner, which envelope comprises a thermally shaped trough-shaped part **43** in the foil material, with a bottom **45**, vertical long and short walls **47** and **49**, respectively, and a circumferential flange **51** which merges into the vertical walls and which is parallel to the bottom **45**. A flat lid **53** which is made from the same foil material lies on the circumferential flange. The strip-shaped conductors **33** are connected to the stack **41** within the foil envelope and are situated between the circumferential flange **51** and the lid **53** of the foil envelope. The lid **53** and the circumferential flange **51** are united to one another by means of heat sealing so as to close the lithium polymer cell hermetically. Since the trough-shaped part and the lid of the foil envelope are manufactured from the same foil material, an excellent fusion between the lid and the trough-shaped part can be achieved through a correct choice of the foil material, and accordingly an excellent hermetic seal. The electrically conducting strips **33** are sealed in into the synthetic-resin material during this process and are accordingly passed through also in a hermetically sealed manner. The heat seal joint is symbolized in FIG. **4** and **5** by means of vertical dashes drawn at the area of the circumferential flange **51** and the portion of the lid **53** resting thereon.

As is apparent especially from FIG. **4** and **5**, the circumferential edge **51** of the foil envelope of the electric cell **5** extends over a stepped part **57** in the width of the ribs **17**, **19** and **21** surrounding the recess **23**. There is therefore no influence on the thickness of the battery unit, whereas the lateral dimension is minimized. Also the circumferential edge **65** of the lid part **3***b* extends over a stepped part **67** of the frame **15**.

The external envelope of the battery unit, see again in particular FIGS. **3** and **4**, also consists of a trough-shaped part **3***a* and a flat lid **3***b*. The trough-shaped part comprises a bottom **9**, vertical long and short walls **11** and **13**, respectively, and a circumferential flange **61** which merges into the vertical walls and which is parallel to the bottom **9**. When the electric cell **5** and the frame **15** are placed in the trough-shaped part **3***a*, it is ensured that the lid **53** of the foil envelope of the electric cell lies against the bottom **9**, see FIG. **4**.

The circumferential flange **61** of the trough-shaped metal part **3***a* of the external envelope is used for fixing the trough-shaped part securely against the frame **15**. It can be seen in FIG. **4** and **5** that a portion of the circumferential flange **61** is bent back so as to lie over the frame **15**. The bent-back portion **61***a* of the flange **61** accounts for only part of the width of the relevant ribs **17** and **19** of the frame **15**. The remaining portion **61***b* of the circumferential flange **61** together with the opposed portion of the bent portion **61***a* forms a circumferential rim which may be used for positioning and fastening of the battery unit in an appliance, such as the portable telephones **55** of FIG. **5**.

The flat lid **3***b* of the external envelope lies within the circumference of the bent-back portion **61***a* of the flange **61**. It rests on the stepped portions **67** of the ribs **17**, **19** and **21** of the frame **15**. Said bent portion **61***a* of the flange **61** as well as the lid **3***b* is securely connected to the frame **15**, for example by means of gluing. Any known techniques, as desired, may be used for the gluing process. Interposed strips of two-sided adhesive material may also be used for this and/or glue types which are activated under the influence of heat, etc. Fastening methods other than gluing may also be used (screwing, riveting, welding, etc.).

The PCB **27** may be provided on the lid part **3***b* of the external envelope, for example by means of gluing, at the area of a aperture **63**. The frame **15** and the PCB are so co-ordinated with one another by ridges **69** that the PCB is held clamped by the frame against the portion of the bottom **9** which surrounds the aperture **63**. The output contacts **7** at the outside of the metal envelope are accessible, see in particular FIG. **1**, on account of the aperture **63**.

As will be apparent from FIG. **5**, the battery unit **1** is exposed to the outside of the telephone device **55**. It is inserted in a groove **59** in such a way that the flange **61** is directed to the inside of the telephone. Therefore the groove **59** may be disposed sufficiently within the telephone housing to guarantee that the groove walls have sufficient strength.

Although the invention has been explained with reference to only a single embodiment, the invention is by no means limited thereto, i.e., in view of the foregoing it will be evident to a person skilled in the art that various modifications may be made within the spirit and the scope of the present invention as hereinafter defined by the appended claims and that the present invention is thus not limited to the examples provided. Thus several electric cells may be present inside the battery unit instead of a single electric cell **5**. These cells could all be individually accommodated in separate recesses of the frame and be electrically interconnected. It is also possible, however, to provide several separate electric cells within a single recess, if so desired. The battery unit need not be of rectangular shape but can in principle have any suitable shape which may be desired, for example for adapting it to the shape of a specific envisaged appliance.

What is claimed is:

1. A battery unit for use in an electronic device, which battery unit comprises a housing with a cell for generating electricity, with output contacts, and with external walls comprising an upper wall, a lower wall and side walls,

the housing being provided with a substantially flat frame with flat ribs and a recess therebetween,

said cell being comprised in said recess, and

said walls forming part of an external envelope of the battery unit, the external envelope substantially being made of metal plating of which at least portions of are provided around the frame.

2. A battery unit as claimed in claim **1**, wherein

the battery unit further comprises a support plate with a printed wiring, with said output contacts, and with connection contacts for connecting said cell to the printed wiring,

the printed wiring being present in a further recess of the frame, separated from said recess in which said cell is present by a separation rib of the frame, and

said separation rib having local depressions for the passage of conductors connecting said cell to the printed wiring within the thickness of the frame.

3. A battery unit as claimed in claim **2**, wherein the printed wiring further comprises electronic circuit elements protecting the battery unit.

4. A battery unit as claimed in claim **1**, wherein

said cell comprises a lithium polymer cell whose general shape is rectangular,

said lithium polymer cell comprising a two-part foil envelope having a trough-shaped part shaped by means of heat and having a bottom, vertical walls and a circumferential flange which merges into the vertical walls and which is parallel to the bottom, and a flat lid provided on the circumferential flange, and

the lid and the circumferential flange being united to one another by means of heat sealing.

5. A battery unit as claimed in claim 4, wherein the frame comprises stepped circumferential parts and the circumferential flange of the two-part foil envelope extends over the stepped circumferential parts of the frame and is disposed within a thickness dimension of the frame.

6. A battery unit as claimed in claim 4, wherein

the external envelope comprises a trough-shaped part with a bottom, vertical walls, and a circumferential flange which merges into the vertical walls and which is parallel to the bottom, and a lid,

said two-part foil envelope of said lithium polymer cell being provided in the trough-shaped part of the external envelope such that the lid of the two-part foil envelope lies against the bottom of said trough-shaped part of the external envelope,

the circumferential flange of the external envelope being bent back over the frame placed therein such that a bent-back portion of said circumferential flange of the external envelope covers part of the width of a rib of the frame,

said lid of the external envelope being provided over the frame so as to lie with a circumferential edge within the bent-back portion of said flange, and

both said bent-back portion and the lid of the external envelope being connected to the frame.

7. A battery unit as claimed in claim 6, wherein the frame is provided with stepped circumferential parts and the circumferential edge of the lid of the external envelope as well as the bent-back portion extend over the stepped part of the frame and are disposed at least partly within a thickness dimension of the frame.

8. A battery unit according to claim 1, wherein the external envelope of the battery unit comprises at a printed wiring which is connected to said cell.

9. A battery unit as claimed in claim 2, wherein the printed wiring further comprises electronic circuit elements for controlling of the battery unit.

10. A portable battery-operated device with a battery unit, said battery unit comprising a housing with a cell for generating electricity, with output contacts, and with external walls comprising an upper wall, a lower wall and side walls,

the housing being provided with a substantially flat frame with flat ribs and a recess therebetween,

said cell being comprised in said recess, and

said walls forming part of an external envelope of the battery unit, the external envelope substantially being made of metal plating of which at least portions are provided around the frame,

said cell comprising a lithium polymer cell whose general shape is rectangular,

said lithium polymer cell comprising a two-part foil envelope having a trough-shaped part shaped by means of heat and having a bottom, vertical walls and a circumferential flange which merges into the vertical walls and which is parallel to the bottom, and a flat lid provided on the circumferential flange, and

the lid and the circumferential flange being united to one another by means of heat sealing,

the external envelope comprising a trough-shaped part with a bottom, vertical walls, and a circumferential flange which merges into the vertical walls and which is parallel to the bottom, and a lid,

said two-part foil envelope of said lithium polymer cell being provided in the trough-shaped part of the external envelope such that the lid of the two-part foil envelope lies against the bottom of said trough-shaped part of the external envelope,

the circumferential flange of the external envelope being bent back over the frame placed therein such that a bent-back portion of said circumferential flange of the external envelope covers part of the width of a rib of the frame,

said lid of the external envelope being provided over the frame so as to lie with a circumferential edge within the bent-back portion, and

both said bent-back portion and the lid of the external envelope being connected to the frame, and

the battery unit being exposed to an outside of the device and being inserted with the external flange in a groove present in the device so as to direct the flange to the inside of the device.

11. A portable battery-operated device with a battery unit, said battery unit comprising:

a housing with external walls comprising an upper wall, a lower wall and side walls;

a substantially flat frame with flat ribs, said frame being comprised inside said housing; and

at least one cell for generating electricity,

said at least one cell being comprised in at least one recess between said flat ribs, said external walls forming part of an external envelope of said battery unit, said external envelope substantially being made of metal plating of which at least portions are provided around the frame.

* * * * *

US006387567B1

(12) **United States Patent**
Noh

(10) **Patent No.: US 6,387,567 B1**
(45) **Date of Patent: May 14, 2002**

(54) **SECONDARY BATTERY**

(75) Inventor: **Hyung-gon Noh**, Seoul (KR)

(73) Assignee: **Samsung SDI Co., Ltd.**, Suwon (KR)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/545,462**

(22) Filed: **Apr. 7, 2000**

(30) **Foreign Application Priority Data**

Apr. 16, 1999 (KR) 99-13497

(51) **Int. Cl.**[7] **H01M 2/06**

(52) **U.S. Cl.** **429/211**; 429/185; 429/181; 429/178; 429/163

(58) **Field of Search** 429/65, 123, 162, 429/163, 178, 181, 185, 211

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Primary Examiner—Carol Chaney
(74) *Attorney, Agent, or Firm*—Leydig, Voit, & Mayer, Ltd.

(57) **ABSTRACT**

A secondary battery includes an electrode assembly formed by sequentially stacking positive electrode plates each having a positive electrode tab formed at one side thereof, negative electrode plate each having a negative electrode tab formed at one side thereof, and separators interposed between the positive electrode plates and the negative electrode plates, for insulating the positive and negative electrode plates from each other, the positive electrode tabs being welded to each other to form a positive electrode tab group, and the negative electrode tabs being welded to each other to form a negative electrode tab group, a case having a lower case part having a space in which the electrode assembly is accommodated, and an upper case part connected to one side periphery of the lower case part and fixed to the lower case part, for hermetically sealing the space of the lower case part, the upper case part and the lower case part having sealing portions at the peripheries thereof to be sealed to each other, a positive electrode terminal welded to the positive electrode tab group, the positive electrode tab group being supported in the sealing portion and protruding outward from the case, a negative electrode terminal welded to the negative electrode tab group, the negative electrode tab group being supported in the sealing portion thereof and protruding outward from the case, and an electrolytic solution blocking member which envelops the electrode assembly. The productivity and safety of the battery can be improved.

9 Claims, 4 Drawing Sheets

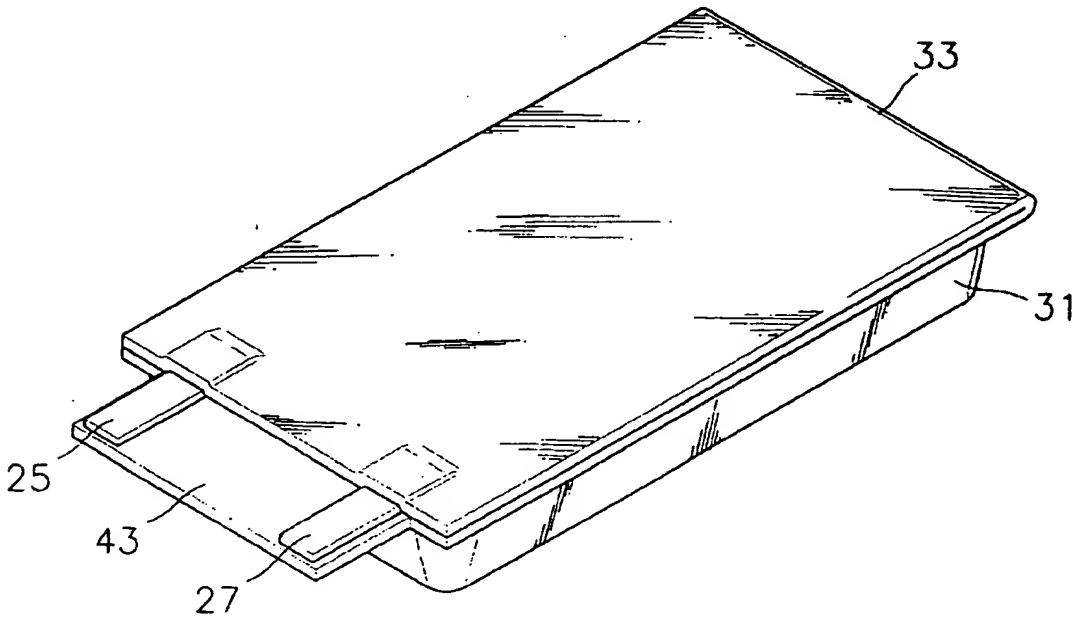


FIG.1 (PRIOR ART)

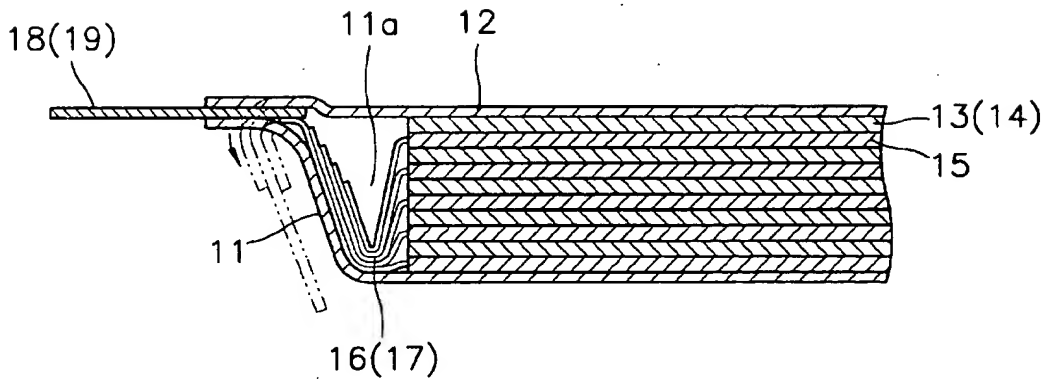


FIG.2

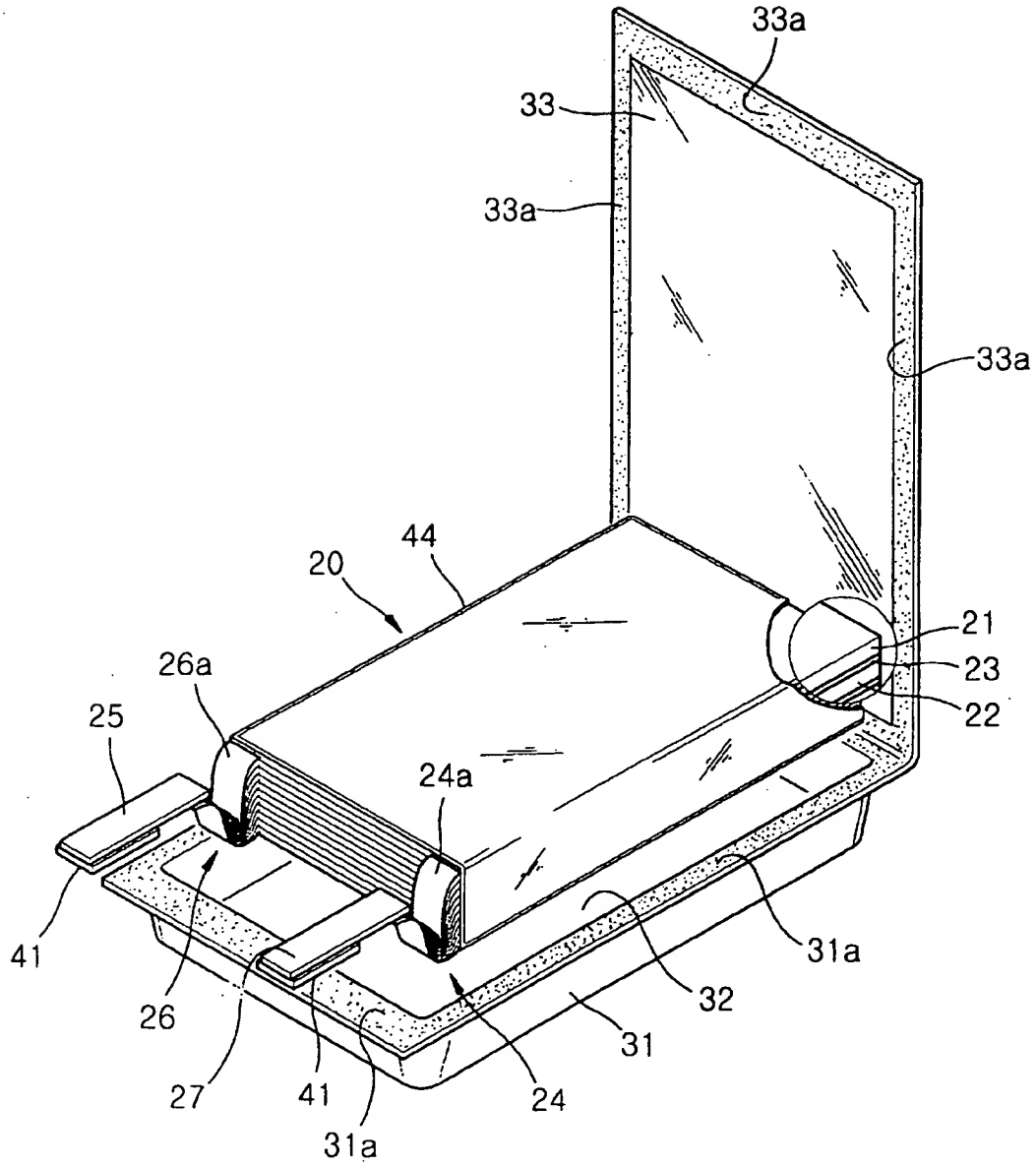


FIG.3

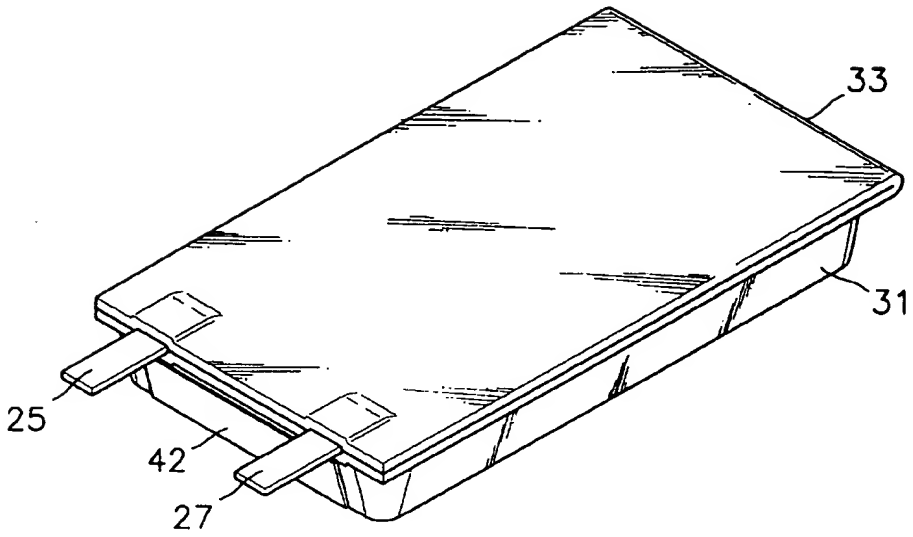


FIG.4

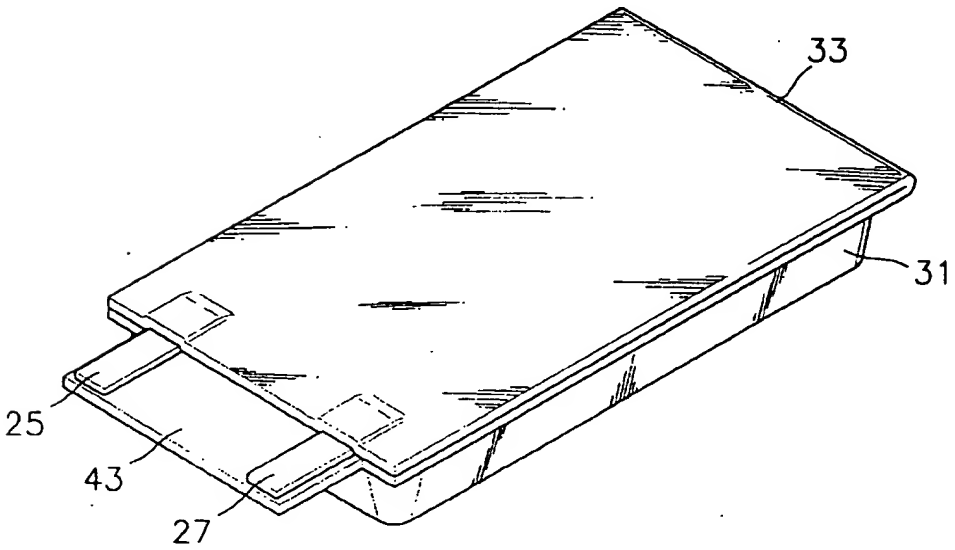


FIG.5

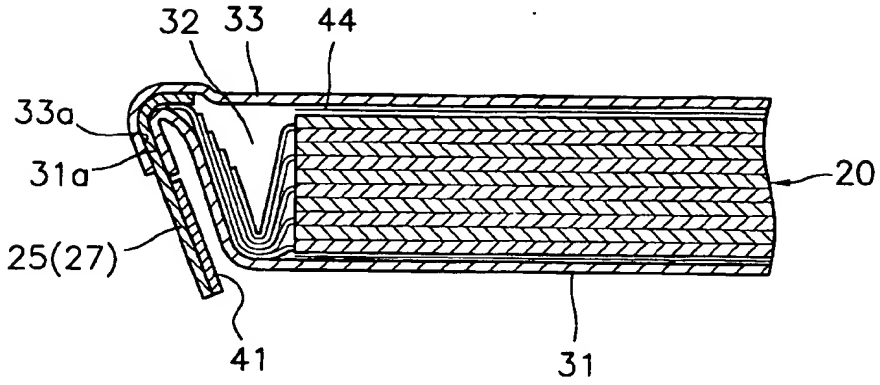


FIG.6

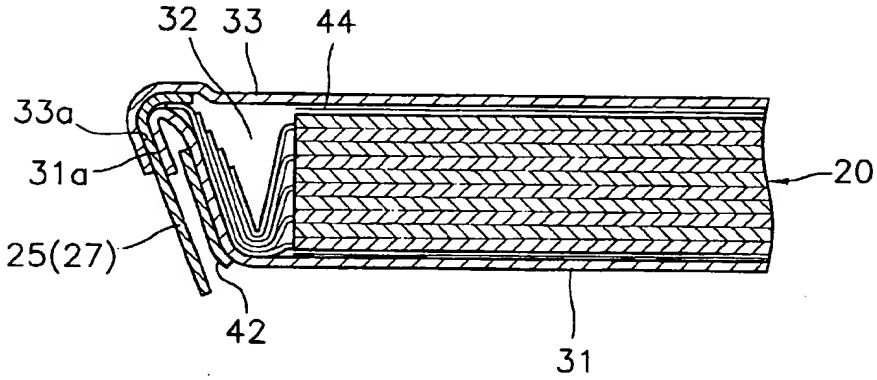
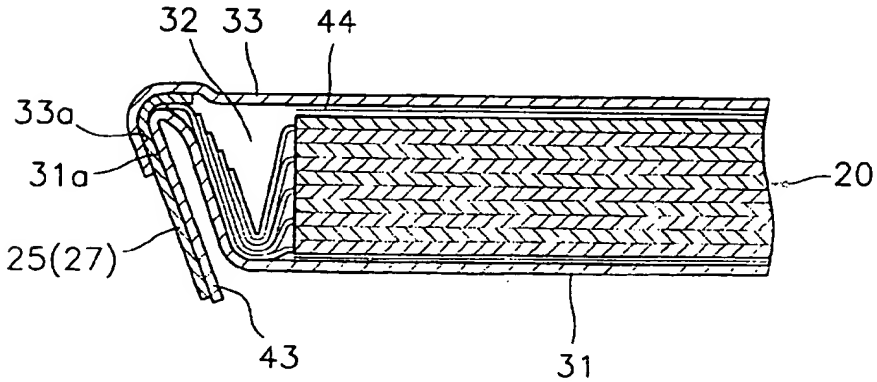


FIG.7



SECONDARY BATTERY

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a secondary battery, and more particularly, to a secondary battery which has an improved structure in which charging and discharging improve the battery capacity.

2. Description of the Related Art

In general, secondary batteries capable of charging and discharging are applied to portable electronic apparatus such as cellular phones, notebook-type computers, computer camcorders and the like, and research into secondary batteries is being vigorously conducted.

In particular, secondary batteries are classified into a variety of batteries, including nickel-cadmium (Ni—Cd) batteries, lead acid storage batteries, nickel metal hydride (Ni—MH) batteries, lithium ion batteries, lithium polymer batteries, metal lithium batteries, air-zinc acid storage batteries, and the like.

Among the above-mentioned batteries, lithium batteries have a service life three times longer than Ni—Cd batteries or Ni—MH batteries and are in widespread use in terms of their excellent energy density per unit weight.

Lithium batteries are classified into liquid electrolyte batteries and polymer electrolyte batteries according to the type of electrolyte used. Generally, batteries using a liquid electrolyte are called lithium ion batteries and batteries using a polymer electrolyte are called lithium polymer batteries.

Lithium secondary batteries may have various shapes. Typically, cylindrical or prismatic batteries are fabricated to be used mainly as lithium-ion batteries. Lithium polymer secondary batteries have flexibility so that they are relatively free in view of shape design. Accordingly, lithium polymer secondary batteries having excellent safety and freedom in shape design and being light-weight are advantageous in attaining miniaturized and light-weight portable electronic apparatus, and research into the lithium polymer secondary battery is being carried out in various manners.

The above-described lithium polymer secondary battery is schematically shown in FIG. 1.

Referring to FIG. 1, the lithium polymer secondary battery includes an electrode assembly, a lower case 11 having a space 11*a* in which the electrode assembly is accommodated, and an upper case 12 for hermetically closing the space 11*a* of the lower case 11. One side periphery of the upper case 12 is connected to the lower case 11.

The electrode assembly has positive electrode plates 13 and negative electrode plates 14 stacked sequentially, with separators 15 interposed therebetween. A positive electrode tab extends from the positive electrode plate 13 at one side thereof and a negative electrode tab extends from the negative electrode plate 14 at one side thereof. A plurality of positive electrode tabs at the positive electrode plates 13 are mutually welded to form a positive electrode tab group 16. Also, a plurality of negative electrode tabs drawn out from the negative electrode plates 14 in the same direction are mutually welded to form a negative electrode tab group 17. A positive electrode terminal 18 and a negative electrode terminal 19 are welded to the positive and negative electrode tab groups 16 and 17, respectively, to then be drawn outside the upper and lower case values 11 and 12.

In the lithium polymer secondary battery having the above-described configuration, the upper and lower cases 11 and 12 which are Al multi-film pouches, are formed of various materials such as nylon, polyethylene (PE), aluminum (Al), ethyl acetic acid (EAA), polyethylene terephthalate (PET), polypropylene (PP) and the like. An electrolytic solution is injected into the upper and lower cases 11 and 12 and then the electrode assembly is installed therein. In this case, when the electrode assembly is inserted into the upper and lower cases 11 and 12 and then the upper and lower cases 11 and 12 are sealed, the electrolytic solution sticking to the portions of the positive electrode tab group 16 and the negative electrode tab group 17 stick to the sealing portions at the peripheries of the upper and lower cases 11 and 12, which results in a sealing strength that is insufficient.

As shown in FIG. 1, the positive electrode terminal 18 made of Al and the negative electrode terminal 19 made of Cu or Ni which protrude outside the upper and lower cases 11 and 12 must be folded to be connected to a terminal (not shown) of a battery pack. However, in this case, the positive and negative electrode terminals 18 and 19 may contact the upper or lower case 11 or 12 in a direction in which the positive and negative electrode terminals 18 and 19 are folded, thereby undesirably causing shorts in the battery.

SUMMARY OF THE INVENTION

To solve the above problems, it is an object of the present invention to provide a secondary battery having improved safety and productivity, by preventing an electrolytic solution from sticking to the sealing portion of a case and preventing a short-circuiting from occurring due to contact between the case and terminals protruding outside the case.

Accordingly, to achieve the above object, there is provided a secondary battery including an electrode assembly formed by sequentially stacking positive electrode plates each having a positive electrode tab formed at one side thereof, negative electrode plate each having a negative electrode tab formed at one side thereof, and separators interposed between the positive electrode plates and the negative electrode plates, for insulating the positive and negative electrode plates from each other, the positive electrode tabs being welded to each other to form a positive electrode tab group, and the negative electrode tabs being welded to each other to form a negative electrode tab group, a case having a lower case part having a space in which the electrode assembly is accommodated, and an upper case part connected to one side periphery of the lower case part and fixed to the lower case part, for hermetically sealing the space of the lower case part, the upper case part and the lower case part having sealing portions at the peripheries thereof to be sealed to each other, a positive electrode terminal welded to the positive electrode tab group, the positive electrode tab group being supported in the sealing portion and protruding outward from the case, a negative electrode terminal welded to the negative electrode tab group, the negative electrode tab group being supported in the sealing portion thereof and protruding outward from the case, and short preventing means provided between the positive and negative electrode terminals and the case in a direction in which the terminals are folded.

In an embodiment of the present invention, the short preventing means,is an insulating member fixed to the positive electrode terminal and the negative electrode terminal.

In still another embodiment of the present invention, the short preventing means is an insulating member fixed to the front sidewall of the case.

Also, in another embodiment of the present invention, the short preventing means is a supporting portion formed by

protruding the sealing portion outward from the case to support the positive and negative electrode terminals.

According to another aspect of the present invention, there is provided a secondary battery including an electrode assembly formed by sequentially stacking positive electrode plates each having a positive electrode tab formed at one side thereof, negative electrode plate each having a negative electrode tab formed at one side thereof, and separators interposed between the positive electrode plates and the negative electrode plates, for insulating the positive and negative electrode plates from each other, the positive electrode tabs being welded to each other to form a positive electrode tab group, and the negative electrode tabs being welded to each other to form a negative electrode tab group, a case having a lower case part having a space in which the electrode assembly is accommodated, and an upper case part connected to one side periphery of the lower case part and fixed to the lower case part, for hermetically sealing the space of the lower case part, the upper case part and the lower case part having sealing portions at the peripheries thereof to be sealed to each other, a positive electrode terminal welded to the positive electrode tab group, the positive electrode tab group being supported in the sealing portion and protruding outward from the case, a negative electrode terminal welded to the negative electrode tab group, the negative electrode tab group being supported in the sealing portion thereof and protruding outward from the case, and an electrolytic solution blocking member which envelops the electrode assembly.

The electrolytic solution blocking member is preferably a film envelop made of one material selected from the group consisting of polyethylene (PE), polyvinyl carbonate (PVC), hexafluoropropylene (HFP) and a mixture of polyvinylidene fluoride (PVDF) and HFP.

Here, short preventing means may be further provided between the positive and negative electrode terminals and the case in a direction in which the terminals are folded.

BRIEF DESCRIPTION OF THE DRAWINGS

The above object and advantages of the present invention will become more apparent by describing in detail a preferred embodiment thereof with reference to the attached drawings in which:

FIG. **1** is a side cross-sectional view schematically illustrating a part of a conventional secondary battery;

FIG. **2** is a partly cut-away exploded view schematically illustrating a secondary battery according to the present invention;

FIGS. **3** and **4** are perspective views illustrating the outward appearance of an assembled secondary battery shown in FIG. **2**; and

FIGS. **5** through **7** are side cross-sectional views schematically illustrating fabrication states of the secondary battery shown in FIG. **2**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Preferred embodiments of the present invention will now be described in detail with reference to the accompanying drawings.

FIG. **2** is a partly cut-away exploded view schematically illustrating a secondary battery according to the present invention.

Referring to FIG. **2**, the secondary battery according to the present invention, for example, a lithium polymer secondary battery includes an electrode assembly **20**, a lower case **31** having a space **32** in which the electrode assembly **20** is accommodated, and an upper case **33** with one side periphery connected to the lower case **31**, for hermetically closing the space **32** of the lower case **31**.

The electrode assembly **20** has positive electrode plates **21** and negative electrode plates **22** stacked sequentially, with separators **23** being interposed therebetween. A positive electrode tab **26***a* extending from the positive electrode plate **21** is formed at one side thereof and a negative electrode tab **24***a* is formed at one side of the negative electrode plate **22**. A plurality of positive electrode tabs **26***a*, each least at the positive electrode plate **21** are mutually welded to form a positive electrode tab group **26**. Also, a plurality of negative electrode tabs **24***a* each drawn out from the negative electrode plate **22** in the same direction are mutually welded to form a negative electrode tab group **24**. A positive electrode terminal **25** and a negative electrode terminal **27** each having predetermined lengths are welded to the positive and negative electrode tab groups **26** and **24**, respectively.

When the electrode assembly **20** having the above-described configuration is inserted into the space **32** of the lower case **31**, the positive electrode tab group **26** and the negative electrode tab group **24** are folded to have a V-shape and the electrode assembly **20** is placed in the space **32**. Sealing portions **31***a* and **33***a* for hermetically covering the space **32** after the electrode assembly **20** is inserted into the space **32** of the lower case **31**, are located at peripheries of the upper and lower cases **33** and **31**. When the sealing portions **31***a* and **33***a* are sealed and the space **32** is hermetically closed, the positive electrode terminal **25** and the negative electrode terminal **27** respectively welded to the positive electrode tab group **26** and the negative electrode tab group **24** are interposed between the contacting portions of the lower case **31** and the upper case **33** and drawn outside the space **32**.

Short-circuit preventing means for preventing a short-circuit due to contact between the positive and negative electrode terminals **25** and **27** and the upper and lower cases **33** and **31** is located at the positive electrode terminal **25** and the negative electrode terminal **27** or at either of the upper case **33** and the lower case **31**, as will be described later.

As a first example of the short preventing means, as shown in FIG. **2**, a first insulating member **41** is fixed to the bottom surfaces of the positive electrode terminal **25** and the negative electrode terminal **27**. In a second example of the short preventing means, as shown in FIG. **3**, a second insulating member **42** is fixed to the front sidewall of the lower case **31**. The first and second insulating members **41** and **42** are made of a PE tape which is an electrical insulating material. However, the material of the first and second insulating members **41** and **42** are not specifically restricted and any material that is easily fixed as an insulating material can be employed.

Alternatively, as a third example of the short preventing means, as shown in FIG. **4**, a supporting portion **43** which is an outward protrusion of the front sealing portion **31***a* of the lower case **31**, supports the positive electrode terminal **25** and the negative electrode terminal **27**.

When the positive electrode terminal **25** and the negative electrode terminal **27** are connected to a battery pack (not shown) for being assembled, the positive electrode terminal **25**, the negative electrode terminal **27** and the sealing portions **31***a* and **33***a* are folded. Generally, the positive electrode terminal **25** and the negative electrode terminal **27** are folded in a direction toward the lower case **31**. Thus, in

the first and second examples of the short preventing means, as shown in FIGS. **2** and **3**, the first and second insulating members **41** and **42** are fixed to the bottom surfaces of the positive electrode terminal **25** and the negative electrode terminal **27**, and to the front sidewall of the lower case **31**, respectively.

However, in the case where the positive electrode terminal **25** and the negative electrode terminal **27** are folded in a direction toward the upper case **33**, the first insulating member **41** should be fixed to the top surfaces of the positive electrode terminal **25** and the negative electrode terminal **27**, and the second insulating member **42** should be fixed to the front sidewall of the upper case **33**.

Referring back to FIG. **2**, in order to prevent the electrolyte solution provided in the electrode assembly **20** from sticking to the sealing portions **31***a* and **33***a*, an electrolytic solution blocking member **44** which envelops the electrode assembly **20** is provided. The electrolyte solution blocking member **44** is formed of a material which does not dissolve in the electrolyte solution and is a film envelop made of one material selected from the group consisting of polyethylene (PE), polyvinyl carbonate (PVC), hexafluoropropylene (HFP) and a mixture of polyvinylidene fluoride (PVDF) and HFP. The electrode assembly **20** is put into the film envelope to then be sealed.

The operation of the aforementioned secondary battery according to the present invention will now be described. Here, the operation of a general secondary battery and a description thereof will be omitted and only the characteristic operation of the secondary battery according to the present invention will be explained.

As described above, the assembled battery unit **20** is immersed in the electrolyte solution, put into the above-described film envelop, that is, the electrolyte solution blocking member **44**, and then inserted into the space **32** of the lower case **31**. Then, the sealing portions **33***a* and **31***a* of the upper and lower cases **33** and **31** are hermetically sealed. Thereafter, the positive electrode terminal **25** and the negative electrode terminal **27** which protrude outward from the front surfaces of the upper and lower cases **33** and **31**, and the sealing portions **31***a* and **33***a*, are folded and packed in the battery pack so as to minimize the volume, thereby completing the secondary battery.

FIG. **5** shows a state where the positive electrode terminal **25**, the negative electrode terminal **27** and the sealing portions **31***a* and **33** are folded in the course of fabricating the battery.

Referring to FIG. **5**, since the electrode assembly **20** to which the electrolyte solution sticks is contained in the electrolyte solution blocking member **44** and is put into the lower case **31** and hermetically sealed with the upper case **33**, the electrolyte solution does not stick to the sealing portions **33***a* and **31***a* of the upper and lowers cases **33** and **31**. As the electrolyte solution blocking member **44**, a PVC film envelope or a film envelop made of a mixture of PVDF and HFP having an excellent elongation ratio is used, thereby enhancing safety such that the film envelope is rolled into a nail during a safety test and an overcharging piercing test.

Also, since the first insulating member **41** is fixed to each of the bottom surfaces of the positive electrode terminal **25** and the negative electrode terminal **27**, even if the positive and negative electrode terminals **25** and **27** contact the lower case **31** as they are folded toward the lower case **31**, short circuits do not occur.

Also, in the case where the second insulating member **42**, instead of the first insulating member **41**, is fixed to the front sidewall of the lower case **31**, as shown in FIG. **6**, even if the positive and negative electrode terminals **25** and **27** contact the lower case **31** as the positive and negative electrode terminals **25** and **27**, the sealing portions **31***a* and **33***a* are folded short circuits do not occur. Further, the supporting portion **43** is molded in such a manner as shown in FIG. **7**, thereby supporting the positive and negative electrode terminals **25** and **27** and preventing short circuits from occurring, even if the positive and negative electrode terminals **25** and **27** are folded toward the lower case **31**.

As described above, the secondary battery according to the present invention has the following advantages.

First, an electrode assembly smeared with an electrolyte solution is enveloped into an electrolyte solution blocking member and inserted into a case to prevent the electrolyte solution from sticking to the sealing portion of the case, thereby attaining an excellent sealing state and remarkably reducing the rate of defect sealing.

Second, in order to prevent short circuits due to contact between positive and negative electrode terminals and the case as the positive and negative electrode terminals which protrude outward from the case are folded during insertion of the battery into a battery pack or connection of terminals, short preventing means, such as an insulating member, is installed in the positive and negative electrode terminals or the case, thereby preventing short circuits in the battery.

Therefore, the productivity of the secondary batteries can be enhanced due to reduction of defects in production and safety thereof can be attained.

While the present invention has been described with respect to what is presently considered to be the preferred embodiment, it is to be understood that the disclosed embodiment is provided only for an exemplary embodiment. To the contrary, the present invention is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims. Accordingly, the true scope and spirit of the invention will be indicated by the following claims.

What is claimed is:

1. A secondary battery comprising:

an electrode assembly including, sequentially stacked,

positive electrode plates, each positive electrode plate having a positive electrode tab at one side,

negative electrode plates, each negative electrode plate having a negative electrode tab at one side, and

separators, interposed between the positive electrode plates and the negative electrode plates, for insulating the positive and negative electrode plates from each other, the positive electrode tabs being welded to each other to form a positive electrode tab group, and the negative electrode tabs being welded to each other to form a negative electrode tab group;

a case having a first case part having a volume in which the electrode assembly is accommodated and a peripherally extending flange, and a second case part having a peripheral flange connected to the peripheral flange of the first case part and fixed to the first case part, hermetically sealing the volume of the first case part, the second case part and the first case part having sealing portions at the respective peripheral flanges sealed to each other;

a positive electrode terminal welded to the positive electrode tab group, the positive electrode tab group being supported in the sealing portion and protruding outward from the case;

a negative electrode terminal welded to the negative electrode tab group, the negative electrode tab group

being supported in the sealing portion and protruding outward from the case, wherein the first case part includes a supporting portion protruding outward from the sealing portion of the first case part, contacting and supporting the positive and negative electrode terminals to prevent short-circuiting.

2. The secondary battery according to claim 1, including an electrolyte solution blocking member enveloping the electrode assembly in the case.

3. The secondary battery according to claim 2, wherein the electrolyte solution blocking member is a film envelope made of a material selected from the group consisting of polyethylene, polyvinyl carbonate, hexafluoropropylene (HFP), and a mixture of polyvinylidene fluoride and HFP.

4. A secondary battery comprising:

an electrode assembly including, sequentially stacked,

positive electrode plates, each positive electrode plate having a positive electrode tab at one side,

negative electrode plates, each negative electrode plate having a negative electrode tab at one side, and

separators interposed between the positive electrode plates and the negative electrode plates, for insulating the positive and negative electrode plates from each other, the positive electrode tabs being welded to each other to form a positive electrode tab group, and the negative electrode tabs being welded to each other to form a negative electrode tab group;

a case having a first case part having a volume in which the electrode assembly is accommodated and a peripherally extending flange, and a second case part having a peripheral flange connected to one the peripheral flange of the first case part and fixed to the first case part, hermetically sealing the volume of the first case part, the second case part and the first case part having sealing portions at the respective peripheral flanges sealed to each other;

a positive electrode terminal welded to the positive electrode tab group, the positive electrode tab group being supported in the sealing portion and protruding outward from the case; and

a negative electrode terminal welded to the negative electrode tab group, the negative electrode tab group being supported in the sealing portion and protrudign outward from the case; and

first and second insulating members respectively fixed to the positive electrode terminal and to the negative electrode terminal, outside and separated from the case, on sides of the positive electrode terminal and the negative electrode terminal closer to the first case part than to the second case part.

5. The secondary battery according to claim 4, including an electrolyte solution blocking member enveloping the electrode assembly in the case.

6. The secondary battery according to claim 5, wherein the electrolyte solution blocking member is a film envelope made of a material selected from the group consisting of polyethylene, polyvinyl carbonate, hexafluoropropylene (HFP), and a mixture of polyvinylidene fluoride and HFP.

7. A secondary battery comprising:

an electrode assembly including, sequentially stacked,

positive electrode plates, each positive electrode plate having a positive electrode tab at one side,

negative electrode plates, each negative electrode plate having a negative electrode tab at one side, and

separators interposed between the positive electrode plates and the negative electrode plates, for insulating the positive and negative electrode plates from each other, the positive electrode tabs being welded to each other to form a positive electrode tab group, and the negative electrode tabs being welded to each other to form a negative electrode tab group;

a case having a first case part having a volume in which the electrode assembly is accommodated and a peripherally extending flange, and a second case part having a peripheral flange connected to one the peripheral flange of the first case part and fixed to the first case part, hermetically sealing the volume of the first case part, the second case part and the first case part having sealed portions at the respective peripheral flanges sealed to each other;

a positive electrode terminal welded to the positive electrode tab group, the positive electrode tab group being supported in the sealing portion and protruding outward from the case;

a negative electrode terminal welded to the negative electrode tab group, the negative electrode tab group being supported in the sealing portion and protruding outward from the case; and

an insulating member fixed to an outside front sidewall of the first case for preventing short-circuiting of the positive and negative electrode terminals when the positive electrode terminal and the negative electrode terminal are bent at the sealing portions toward the first case part.

8. The secondary battery according to claim 7, including an electrolyte solution blocking member enveloping the electrode assembly in the case.

9. The secondary battery according to claim 8, wherein the electrolyte solution blocking member is a film envelope made of a material selected from the group consisting of polyethylene, polyvinyl carbonate, hexafluoropropylene (HFP), and a mixture of polyvinylidene fluoride and HFP.

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